Textbook Of

Deductive Logic

N. Durzie

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Prescribed by the Council of Higher Secondary Education, Orissa
as a Text Book for +2 classes

Text Book of
DEDUCTIVE LOGIC

VOLUME I

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PREFACE TO THE SEVENTH EDITION

It is gratifying to note that the books, both Vol. I and Vol. II, have proved themselves useful to the students of the +2 classes and the need for a new edition is felt so soon.

A number of printing mistakes had crept into the preceding edition because of the hasty publication of the books to cater to the demands of the students, since they went out of stock during the strike period of the printing–press – employees. Sincere attempts have been made to set right those errors in this edition.

The aim of these books has all along been not only to provide adequate materials on all the topics prescribed in the syllabus, but also to deal with matters necessary for a comprehensive knowledge on the fundamental elements and to acquaint the students with concepts helpful to the advanced study of the subject.

For the convenience of the readers, every discussion as far as practicable, has been made self–sufficient. So the beginners need have no fear of having a mutilated or distorted knowledge of things, even if they omit the study of some portions of some chapters or even whole chapters as per requirements of the syllabus.

Readers desirous of acquiring knowledge of the advanced works on modern logic, however, cannot afford to ignore any topic included in these books.

N. Durzie

Ganesh Puja, 1984

PAPER-II

2nd Year of +2 Course or class – XII

1. Nature, Problem and procedure of Induction.
2. Induction Proper and Induction Improperly so-called.
3. Grounds of Induction-Formal Ground-Laws of uniformity of Nature and Causation-Scientific and popular view of causation-cause and condition-Quantitative and Qualitative view of causation-Doctrine of Plurality of causes. Conjuction of causes and Intermixture of Effects.
4. Hypothesis-Conditions of Legitimate Hypothesis-Proofs of Hypothesis.
5. Material Ground-Observation and Experiment.
6. The Experimental Methods-Method of Agreement, Method of Difference, Joint Method of Agreement and Difference, Method of Concomitant Variation and Method of Residues. Concept of Vyapti.
7. Fallacies-Deductive-Logical and Non-logical.
8. Fallacies-Inductive.

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tells us how it should be expressed or presented in language so that ambiguity may not arise and either the validity of our inference is appreciated, or if there be any error, it is easily detected.

Inference and Argument - ଅନୁମାନ ଏବଂ ଯୁକ୍ତି

Inference is a mental phenomenon. It may mean the mental process of deriving new judgements from judgements already taken as true or false. It may also mean the mental product of such processes. As a mental process, inference is the subject-matter of Psychology. Psychology studies how we do think or reason or infer. Logic has nothing to do with it. Logic, however, does take into consideration inference as a product. It examines whether the resulting judgement does validly follow from the already assumed judgements or not. It tells, therefore, how we should infer rather than how we do infer.

An inference, when expressed in language, is called an argument. Ascertaining the validity or invalidity of argument is the proper subject-matter of Logic. In an argument, a conclusion is drawn from one or more premises. It is the business of Logic to examine whether the conclusion does follow from or implied by the premises or not. If the premises do justify the conclusion, the argument is declared to be valid. But if the conclusion is not implied by the premises, in other words, if the conclusion does not necessarily follow from or is not justified by the premises, the argumen is declared to be invalid.

'All beasts are black; parrot is a beast; therefore parrot is black' This is a valid argument, though all the propositions here are false since the conclusion 'parrot is black' necessarily follows from or i implied by the two premises taken jointly. But "All Indians ar mortal, all Oriyas are mortal, therefore all Oriyas are Indians" is a invalid argument, though all the propositions here are true, sinc the conclusion 'Oriyas are Indians' does not necessarily follow fro or is not implied by the two premises. Oriyas are Indians, nc

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because both Oriyas and Indians are mortal, but because Orissa is a part of India.

From the above it is clear that Logic is directly concerned with validity rather than with truth. In order to realise the validity or invalidity of an argument, it is necessary to look into the implication of the premises, not to their truth. Further, though inference and argument both may be either valid or invalid, the validity of an inference can be tested only when it is expressed as an argument. Inference being a mental entity, the rules of Logic cannot be applied to it directly. When it is expressed in language as a unit involving some propositions, we may test by the application of the rules of Logic whether the premises justify the conclusion or not. In this sense, Logic is directly concerned with arguments and only indirectly concerned with inferences.

Truth and Validity

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An agrument consists of propositions. But the ascertainment of their values differs. A proposition may be true or false but an argument is either valid or invalid.

In order to determine the truth or falsity of a proposition, different methods may be necessary in different cases. No empirical experience is necessary to know the truth of a proposition like 'a thing is greater than its half' or the falsity of a proposition like 'a red rose is not red'. To know the truth or falsity of propositions like 'Varanasi is on the bank of the river Ganga' and 'Mahatma Gandhi was born in Orissa', empirical evidence is necessary. Again, empirical evidence, howsoever wide, may not be considered adequate to justify the truth of a proposition like 'all crows are black', while empirical evidence of a single white crow is sufficient to falsify this proposition. Thus a general proposition is not definitely verifiable, but it is definitely falsifiable. In any case, though a proposition must have been either true or false, it is known to be so only when proper evidence is discovered.

The validity of an argument does not depend on the truth or falsity of the constituent propositions; it depends rather on their significance or implication. In the significance of the proposition 'Ram marries Sita', 'Sita marries Ram' is implied. But in the significance of the proposition 'Ram loves Sita', 'Sita loves Ram' is not implied. If Lava is the twin of Kusha, Kusha is also the twin of Lava But if Lava is the son of Ram, Ram cannot be the son of Lava. So in order to determine the validity of an argument, it is not the truth but the significance of the premises that is looked into. All the propositions involved in an argument may be true, but still the argument may be invalid, *e.g.*,

The Sun is bright.
The grass is green.
∴ Ram is mortal.

Here, the argument is invalid, because the conclusion is no implied by the premises. The premises, though true, do not suppl the slightest evidence for the justification of the truth of the conclusion.

An argument may be valid even if all the propositions involve are false, e.g.,

Triangles are circles.
Circles are squares.
∴ Triangles are squares.

Here, the argument is taken as valid, because the conclusion implied by the premises. In fact, in order to realise the validity invalidity of some arguments it is not necessary to know the mea ings of the terms used. Whatever the terms, triangles, circles a squares may mean, the argument cited above remains valid, becau if we take all triangles to be necessarily circles and all circles to necessarily squares, we cannot at the same time assert that still 'so triangles may not be squares'. Again, if we do assert this lat proposition, it is necessary that some alterations to justify it m be made in the premises. So, whatever A, B, C may be, 'All A is B; All B is C; ∴ All A is C' is a valid form of argument. A form of argument is said to be valid when it cannot be that we take the premises to be true and the conclusion to be false. Thus though truth and validity are distinct, they are inter-related. It is the main business of Logic to discover valid forms of argument, which when applied to concrete cases, give us inferential knowledge.

When the argument is valid and the premises are materially true, the conclusion is bound to be materially true. But when the argument is invalid, even if the premises are materially true, we cannot say anything regarding the truth or falsity of the conclusion.

Science and Art

Science is a systematic, precise and accurate body of knowledge on a definite department of the world. It attempts to discover the general laws regulating the phenomena of its particular department by observation and experiment and arranges them in an order to build a system. Botany is a science, which studies plant life. Astronomy is a science, which studies the heavenly bodies. Psychology is a science, which studies mental phenomena and so on.

Science has the following characteristics.

(1) Every science has a definite subject-matter.

A layman may be satisfied in having commonsense knowledge, that is rough and ready knowledge, regarding all the things in which he is interested. But a scientist is interested in having accurate, precise and detailed knowledge of only the subject of his study. So the subject-matter of every science is limited to a particular department of the world. Thus it may be said that while the layman is jack of all trades, the scientist is a master of one. There is a need for comparative study in science and the discoveries of one department may be made use of in another department. But the aim of every science is development and progress in its own specific department.

(2) The aim of every science is to discover general laws in the field of its study.

A layman may be interested to know why the plants of hi garden do not grow well or how can he have the love of hi neighbours. But a scientist is interested in knowing the genera conditions which regulate the growth of plants and the genera conditions which bring about the love between two individuals Thus the scientist discovers laws which are applicable in all simila cases of a particular kind. He is interested in particular facts only i so far as they are steps to the general laws. When such laws ar discovered and proved, they give us knowledge of all things of particular kind observed or unobserved, of past, present or future

(3) Scientific knowledge is certain and reliable.

Scientific knowledge is the outcome of accurate observations well-planned experiments and progressive research. The scientis invents and makes use of instruments that increase the capacity o the natural and normal sense organs. So scientific knowledge be comes certain, reliable and more useful than unscientific knowledge

(4) Scientific knowledge is systematic and methodical.

No definite method is followed in acquiring knowledge in ou day-to-day life. But scientific knowledge is acquired by adopting definite procedure. Superstitions, fond beliefs and supernatura explanations have no place in science. Contradictory proposition cannot both be true. So pieces of knowledge derived from differen researches must be suitable so as to be systematised and mad consistent. Otherwise they stand in need of being modified. Scientific knowledge is considered incomplete unless it is systematic an harmonious.

The term 'Art' is used in two senses. It may be used in the sens of some sort of skill or knack in producing something beautiful. I this sense, singing, dancing, painting, etc. are arts. It may also b used in the sense of practical application of knowledge in order t achieve some end. In this sense, surgery, navigation, cooking, et are arts. Surgery makes practical application of the knowledge of anatomy, physiology, etc. and formulates certain rules for the use of surgical instruments in order to set right some bodily defects.

Thus, it may be noticed that while the aim of science is to acquire knowledge, the aim of art is to apply knowledge for realising a practical end. Thomson says, "A science teaches us to know and an art to do." Mill says, "The language of science is—this is or this is not, this does or does not happen. The language of art is—do this, avoid that."

However, it may be noted that science and art are not opposed to each other. They are rather interdependent. Theory and practice, knowledge and action usually go together. Science without art remains abstract and unproductive, and art without science is uncertain and unreliable. So science and art are complementary of each other. Every developed study has both a theoretical and a practical side. We call it a science, when its theoretical aspect is stressed, and we call it an art when its practical aspect is stressed.

Is Logic a science or an art ?

There is difference of opinion among logicians with regard to the question whether Logic is a science or an art. Ueberweg, Thomson, Hamilton, etc. consider Logic to be a science, whereas Aldrich considers it to be an art. Again, Whately considers it to be both a science and an art and Duns Scotus describes it to be the science of sciences and art of arts.

Since Logic is a systematic study of the valid forms of reasoning, it is surely a science. But it also applies this knowledge in order to get truth and avoid errors. So it is also an art. It is proper, therefore, to consider Logic to be both a science and an art. Further, since the aim of every science is to get true knowledge of the specific subject-matter of its study, it is bound to apply the principles of valid reasoning discovered by Logic. And in this sense, the description of Logic as the science of sciences is justified. Similarly, since every art also be considered as a too wide definition, because 'thought' is no necessarily confined to inference or reasoning. Thinking is involved in perception, memory, imagination,etc.,but Logic is not concerned with them. Logic has also nothing to do with thought as it is, o thought as a process. It is not a positive science like Psychology bu a normative science. It deals with valid thinking or thought as i should be in order that the premises may justify the conclusions.

Albertus Magnus defines Logic as "the science of argumentation." Spalding defines Logic as "the theory of inference."

These definitions are clearly too narrow, because they tak Logic to be merely a science whereas it is both a science and an art Further, though inference and argument are the main concern o Logic, it also has to discuss about terms and propositions and th *subsidiary processes like definition*, division, naming,etc.

Ueberweg defines Logic as "the science of the regulative law *of human knowledge*." The Port Royal Logicians define Logic a "*the science* of the operations of the human understanding i *pursuit* of truth." Arnauld defines Logic as "the science of th understanding in pursuit of truth."

These definitions stress the theoretical aspect of Logic b describing it to be a science. Again, 'knowledge and truth' may b both immediate and mediate. But Logic is concerned only wit mediate or inferential truth or knowledge. So these definitions ar in this respect too wide.

Aldrich defines Logic as "the art of reasoning."

This definition takes Logic to be only an art. It has complete ignored the theoretical aspect and so it is too narrow.

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processes like definition, division, naming etc. have been completely ignored.

It is clear from the above that it is difficult to give a short definition of Logic without committing the fallacy of either too wide or too narrow definition. The following is an attempt at an adequate definition of Logic which avoids both the above fallacies.

Logic is the science and art of ascertaining valid forms of reasoning by a study of its constituent parts and auxiliary processes.

The definition involves the following characteristics of Logic :

(i) It is both a science and an art. Pure Logic is a science but applied Logic is an art. This definition covers both these aspects of Logic.

(ii) Its aim is ascertainment of valid forms of reasoning by a study of the implication.

(iii) For this purpose it studies the constituent parts of reasoning, i.e., propositions and terms.

(iv) It also studies the auxiliary processes connected with reasoning, i.e., definition, division, classification, etc.

(v) As a science, it discovers the general principles involved in valid reasoning. As an art, it acquaints us with the fallacies which we are to guard against.

(vi) Logic as a science being primarily concerned with implication is not concerned directly with truth. But Logic as an art is concerned with inferential truth.

Deductive and Inductive Logic

Logic is usually divided into two parts, *viz.,* deductive and inductive.

Deductive Logic deals mainly with deductive reasoning or deduction, while Inductive Logic deals mainly with inductive reasoning or induction. In deduction, we pass from higher generality these two colours, because green and not-green exhaust all colour So two contradictory qualities cannot both be taken to be false of thing. In knowledge situation, we take a proposition to be eith true or false. In reasoning, the falsity of a proposition necessaril implies the truth of its contradictory. The falsity of any propositio is equivalent to the truth of its contradictory. This principle is calle the Law of Excluded Middle, because it exposes that nothin remains in the middle of two contradictory terms; the middle i excluded. Symbolically, it can be stated as 'either p is true, or p i false'. Jevons says, "The very name of the law expresses the fact tha there is no third or middle course; the answer must be Yes or No"

These three principles are equally fundamental and none o them can be derived from the others. But they are interrelated. The assertion of one of them is confirmed by the others. The law o identity states that a tiger is a tiger. But a tiger remaining a tiger may be big or small, young or old, caged or free and so on. The law of contradiction states that the tiger cannot be both big and not-big; young and not-young; caged and not-caged and so on. This law states what the tiger cannot be. So this law introduces the conception of negation, which is not there in the Law of Identity and thus is fundamentally different from it. Again while the law of contradiction denies the attribution of two contradictory qualities of a thing, the Law of Excluded Middle asserts the necessary attribution of one of these two contradictory qualities. Of course, a tiger, which remains a tiger (law of identity) cannot be both big and not-big (law of contradiction), but it must be one of these (law of excluded middle). So the Law of Excluded Middle is also fundamentally different from the others. It is, however, evident that all the three laws are made use of in knowledge situation and in consistent thinking.

Criticism of the three laws

The modern logicians have very severely criticised "the three laws of thought". It is said that they are neither *laws* nor *the* laws nor the laws of *thought*. They are not laws, because laws are either uniformities (laws of nature) or commands (laws of state), but these so-called laws are neither of these. So, it is better to call them principles rather than laws. They are guiding principles of valid reasoning or consistent thought. As such, they are not the only laws, but there are also other laws, which serve the same purpose; and so they cannot be said to be *the* laws. Further they cannot be said to be the laws of *thought*, because generally, thinking, which is a psychological process, is controlled at least partially by our emotion and prejudices. We do not always think logically. So, these laws are not made true by the way in which men do think. They are not psychological laws, but 'logical principles' involved in rational thinking.

Some of the other principles involved in rational thinking may briefly be noted here.

Principle of Syllogism—If p implies q, and q implies r, then p implies r.

Principle of Deduction— If p implies q, and p is true, then q is true.

Principle of Substitution— Whatever can be asserted of *any instance however chosen* can be asserted of *any given instance.*

It is undoubtedly true, however, that the "three laws of thought" are some of the fundamental principles involved in coherent thinking and cogent argument and deductive Logic must assume their truth. Besides them, inductive Logic assumes two other laws to be fundamental. They are 'the Law of Uniformity of Nature' and 'the Law of Universal Causation'. The law of Uniformity of Nature states that Nature behaves uniformly and the Law of Causation states that every event has a cause. Leibnitz takes 'the Law of Sufficient Reason' as another fundamental principle, which is involved both in deductive and inductive reasoning. It states that "Nothing happens without a reason why it should be so rather than otherwise."

EXERCISE

1. Distinguish between :
   (a) Direct and Indirect knowledge
   (b) Inference and Argument
   (c) Science and Art
2. Is Logic a Science or an Art ? Discuss.
3. Define Logic and state what kind of a science it is.
4. Explain clearly the distinction between Deductive and Inductive Logic.
5. Distinguish between Truth and Validity. How is Logic connected with them
6. Give a critical exposition of the three laws of thought.
7. Examine the correctness of the following definitions of Logic :
   (a) It is "the theory of inference".
   (b) It is "the science of the understanding in pursuit of truth."
   (c) It is "the science and also the art of reasoning."
8. Justify the following statements :
   (a) An argument may be valid though all the constituent propositions are false.
   (b) Logic is the science of sciences and art of arts.
   (c) The Laws of thought are neither Laws nor Laws of thought.
9. What is the Scope of Logic ? Attempt a definition of Logic in your own language to indicate its scope.
10. Write an essay on the utility of Logic.

2

Term

Word, term and name

Word is a letter or combination of letters, e.g., a, I, man, good. It may be of two kinds, viz., sensible and nonsensical. Sensible words have sense or meaning. They indicate thing, quality, action, relation, etc. e.g., man, honest, run. Nonsensical words have no sense or meaning, e.g., myn, ged. We do not know what do they mean. But if somebody points out that 'myn' means a kind of fish and 'ged' is the name of a flower, then they are no longer nonsensical. Some logicians do not take a nonsensical combination of letters to be a word. They name it as 'noise'. Words, according to them, are always meaningful. Thus, 'man' is a word, but 'myn' is not a word, it is only a noise.

Term, according to the Traditional Logicians, is a word or combination of words which can be used as the subject or predicate of a logical proposition. 'Ram is good' is a proposition in which 'Ram' and 'good' are terms. Similarly, in the proposition 'Ram, the son of Dasarath, is depicted in the Ramayana as a good and wise ruler', the terms 'Ram, the son of Dasarath' and 'depicted in the Ramayana as a good and wise ruler' are terms.

The word 'Term' is used either in a wide sense or in a narrow sense. Any word, or combination of words which *can be used* as the subject or the predicate of a logical proposition is a term in the wide sense. But 'Term' in the narrow sense means only those words or combinations of words which have *actually been used* as subject or predicate. 'That man', 'good', 'palm trees', 'tall' are terms in the wide sense, but they are not terms in the narrow sense. They become terms only when they are used in propositions like 'That man is good', 'Palm trees are tall'.

All terms are words but all words are not terms. Only those words, which can be used as subject or predicate, are terms. Such words are called Categorematic words, e.g., man, good. Syncategorematic words, on the other hand, are words which cannot be used independently as subject or predicate, but they can becom parts of subject or predicate, i.e., they along with other word become subject or predicate in propositions, e.g., and, of—in th proposition : Ram *and* Hari are people *of* Orissa. Besides thes there are some other words which are called Acategorematic. Suc words can become neither subject or predicate nor parts of subje or predicate, e.g., Ah !, Oh !. These words express sudden emoti and form no part of the proposition that may follow. "Oh ! my he is bursting with pain." Here 'Oh !' is a part neither of the subject n of the predicate.

It may be remarked that unless a word is used in a statem it cannot be said whether it is categorematic, syncategorematic acategorematic. Words used as noun, pronoun and adjective generally categorematic; words used as verb, adverb, preposi and conjunction are generally syncategorematic and words use interjection are acategorematic. 'His pictures are excellent.' H 'excellent' is used categorematically. "Excellent pictures are uni sally appreciated." Here 'excellent' is used syncategoremati 'Excellent ! you have reached at the right moment.'' H 'Excellent' is used acategorematically. 'Ram and Hari are peop Orissa.' Here 'and' is a conjunction, 'of' is a preposition, they syncategorematic. But in the propositions, *'and' is a conjun* *'of' is a preposition,* the words 'and' and 'of' are nouns an categorematic. Similarly in 'Ah ! your prediction has come true', is acategorematic, but in the proposition 'Ah ! is acategorem 'Ah !' is categorematic.

All categorematic words are terms in the wide sense; but syncategorematic and acategorematic words are not terms.

Names are words which indicate something which may be real or imaginary. India is the name of a country which exists; 'El dorado' is the name of an imaginary country. General names are given to classes of similar things to each of which the name is applicable. Cow is the name of a class of animals and each individual of the class bears that name. Proper names are given to individuals. India is the proper name of a country. The Mahanadi is the proper name of a river in Orissa.

Names are terms in the wide sense.

Symbol and meaning

We use signs to convey our meanings. A sign indicates something other than itself. The crying of a baby is the sign of his unhappiness or discomfort. Rapidity of heart-beats is the sign of disturbed emotional state. These are natural signs. But there may also be conventional signs. Rising from the seat or raising the folded palms to the forehead is the conventional sign of showing respect. A conventional sign is called a symbol. A sign or symbol conveys the meaning only to those who understand it. So a sign to be significant, it is necessary that there should be (i) the sign, (ii) the meaning which it signifies, and (iii) the interpreter who knows the relation between the two.

Symbols may be verbal or non-verbal. Words are verbal symbols. 'Dog' is the verbal symbol, which means the well-known quadruped that guards our home. 'Food' is the verbal symbol, which means the things that are eatable. +, –, ×, ÷ are non-verbal symbols used in Mathematics for some mathematical operations. Gestures and postures in dancing are non-verbal symbols.

From this standpoint a distinction is drawn between word and term. A word is the symbol for the thing, quality or action it indicates. So, it is different from its meaning. But in the corresponding term of individuals, not classes. A class term, e.g., flying horse has denotation, because no such animal exists. It is an empty class null class, but its extension comprises the sub-classes big flying hor and small flying horse, though, of course, these sub-classes are al empty.

Inverse Variation between Denotation and Connotation

Traditional logicians hold the view that there exists a relatio of inverse variation between denotation and connotation. Whe one of these increases, the other decreases and *vice versa*. Thus fo example, if we increase the denotation of man by including othe animals in it, then all these beings can no longer be termed 'man They can properly be called 'animal' and the corresponding co notation becomes only 'animality'. So, the connotation decrease from animality and rationality to only animality. Again, if w decrease the denotation of man by excluding all dishonest men, the the term applicable to the remaining individuals is 'honest man' an the connotation becomes animality, rationality and honesty. Thus the connotation increases.

The connotation of the term 'black snake' is snakeness an blackness. To this connotation if we add Indianness and increase it then the term becomes 'Indian black snake' and the denotation naturally decreases, because black snakes of countries other tha India are excluded from the denotation of black snake. Similarly, i we decrease the connotation of black snake by excluding blackness the term becomes 'snake' and the denotation, by including snake of all colours, increases.

It is admitted by the upholders of this law that the variation not mathematical. The addition of one quality to the connotatio of a term sometimes brings about a great decrease in the denotatio and sometimes the decrease is trivial. If we add blindness to th connotation of Politician, the decrease in denotation is very gre but if we add literate to it, the decrease is trivial.

Critics have raised several objections with regard to the applicability of this law, which need elucidation.

It is pointed out that this law is not applicable in the case of increase or decrease of the connotation of a term by scientific research. Let us suppose that conventionally three characteristics a, b and c are accepted to constitute the connotation of a term. If by scientific research it is found out that another characteristic 'd' is also equally essential and should be included in the connotation, then the connotation increases. Similarly, if it be found out that 'c' is not an essential quality and so the connotation should comprise only of a and b, then the connotation decreases. But under both these circumstances, the denotation does not undergo any change.

Some logicians in order to save the law, argue on this point that here, in fact, the connotation has not changed at all. It is only our knowledge of the connotation, which has changed and so the denotation, in accordance with the law, need not change. But this position implies that the connotation of every term is eternally and absolutely fixed and, perhaps, we never know exactly how many characteristics are there in it.

Some logicians point out that sometimes a term lacking denotation comes to have a denotation. 'Plastic house' is an empty or null class, but in future if a house is made of plastic it will have a denotation. The term 'black swan' was supposed to have no denotation, but now since the discovery of black swans in Australia, it has come to have a denotation. The term 'living Indians' appears to have a varying denotation, since Indians are born and also die. But the connotation in all these cases is unaffected. Some logicians have tried to save the law by arguing that the denotation of a term never changes, since it includes all past, present and future individuals. The present individuals, by becoming past ones, or the future individuals by becoming present ones, the denotation according to them, remains unaffected.

It is clear from the above discussion that this law is not applicable in the case of a single term, whether the connotation and denotation be unalterable or alterable. This law is also obviously inapplicable in the case of a number of unconnected terms like 'goat', 'elephant' and 'snake'.

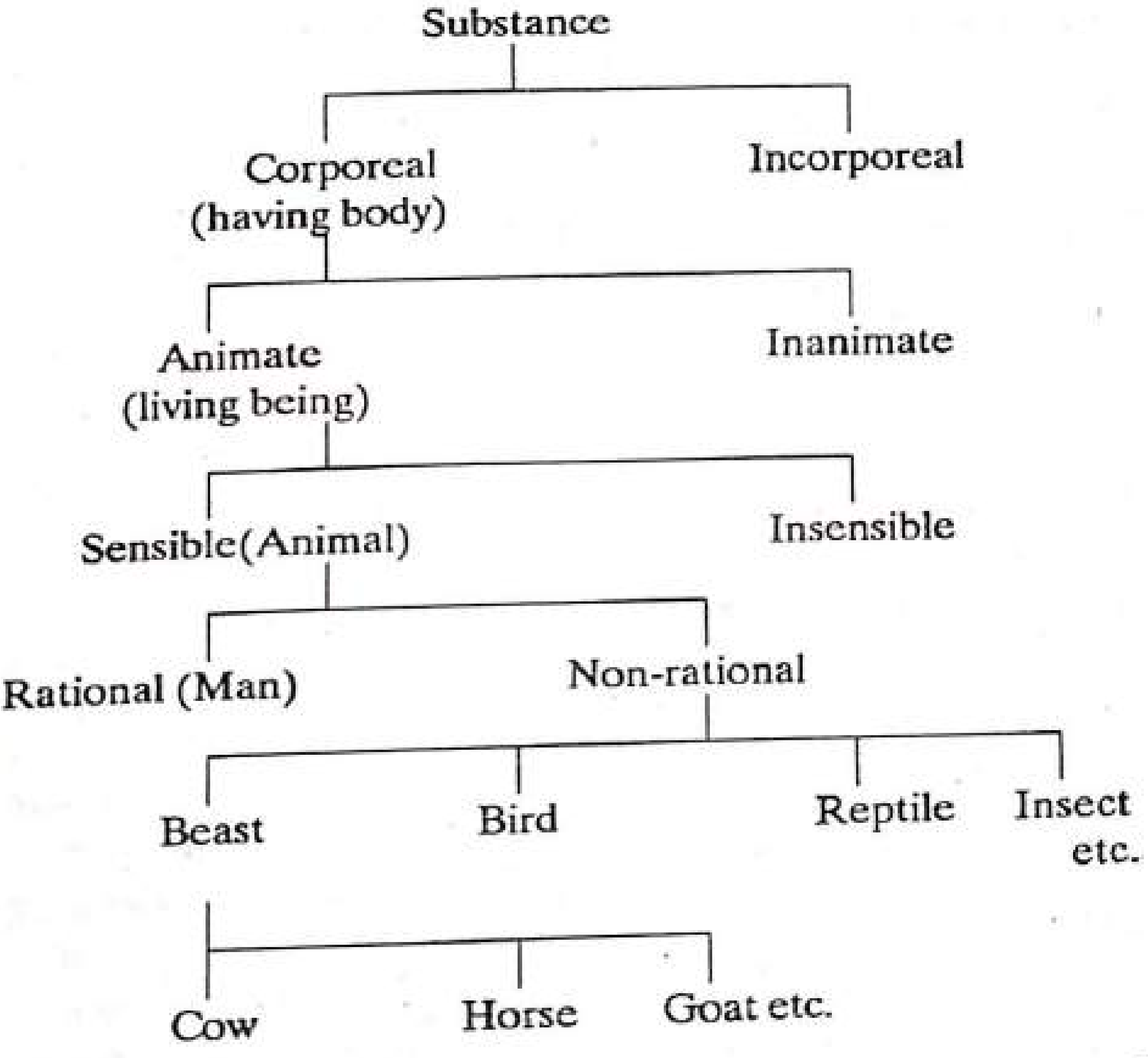
For the purpose of the application of such a law, it is necessary that we take terms like 'goat', 'black goat', 'black big goat' or 'elephant', 'Indian elephant', 'Indian old elephant' etc. So the modern logicians point out that there is no inverse variation between the denotation and connotation of a term, but there does exist such a relation between the connotation and extension.

The denotation of a class is concerned with individuals, but the extension is concerned with sub-classes. The extension of goat is all the sub-classes of goat. Now, by enriching the connotation of 'goat' by the addition of the characteristic 'blackness', we naturally exclude all other sub-classes, e.g., white goat, brown goat etc., and thus the extension is decreased. By further enriching this connotation by the addition of the characteristic 'bigness', we get only the subclass 'big black goat' and the extension is automatically narrowed since the sub-classes 'small black goat' and 'medium-sized black goat' must be excluded. Similarly, by decreasing the connotation of Indian elephants,i.e., 'Indianness' and 'elephantness' by the omission of the characteristic 'Indianness', we shall have to increase the extension since the sub-classes, Burmese elephants, Ceylonese elephants, African elephants etc., are to be added. It is immaterial for this purpose whether the class or sub-classes have denotations or not. 'Flying horse' may lack denotation, but it extends over 'black flying horse' and 'not-black flying horse' and this law is equally well applicable there. Man and mortal man have the same denotation, but the law still holds good though the sub-class 'immortal man' is an empty class.

Relation of terms from the standpoint of extension

If we examine the extensions of terms, we find that the extensions of some terms are included in the extensions of some other terms. If the extension of A includes the extension of B, then A is called the *genus* of B and B is called the *species* of A. Thus, for example, animal is the genus of man, and man is the species of animal. Again, man is the genus of student and student is the species of man. So genus and species are relative terms.

We may divide substance in the following manner.



In this table any term is the genus of its subordinate term which is under it, and the species of the superordinate term which is above it. Terms on the same level, i.e., the species of the same genus are co-ordinate of each other and are called co-ordinate or cognate species. Thus Animate being is the genus of Sensible being, species of Corporeal being, and *co-ordinate species* of Inanimate being.

Similarly, Beast is the genus of Cow, species of Non-rational anima and co-ordinate species of Bird. Non-rational animal is th proximate genus of Beast, but *remote genus* of Cow. Similarly, it i the *proximate species* of Sensible animal, but *remote species* o Corporeal being. Substance, which is the term having the wides extension so that it is genus in relation to its subordinateterms bu species of none, is called *Summum Genus.* A term of narrowes extension, which is species of its higher classes but genus of none i called *Infima Species*. It is difficult to give an example of Infima species, because the possibility of dividing any class to furthe sub-classes cannot easily be ruled out. From the standpoint of natural subclasses of Beast, Cow or Horse may be supposed to be infima species but the possibility of dividing them as big, small or medium-sized or as white, black etc., still remains. All the terms between the Summum Genus and the Infima species are called *Subaltern genera and species,* because they are genus or species of other classes according as we take a lower or a higher class in relation to any one of them.

Relation of terms from the standpoint of connotation

The genus includes the species from the standpoint of extension. But the connotation of species includes the connotation of the genus. This must be so, because when the extension is comparatively narrow, the connotation is comparatively wide. Man is a species of Animal and has a narrower extension. But its connotation comprises both animality and rationality and thus has more characteristics than that of Animal. The additional characteristic in the connotation of the species over the connotation of the genus is called the *Differentia,* because it differentiates the species from its genus and other co-ordinate species. Rationality is the differentia or distinguishing characteristic of man, which is found in men but not found in other animals.

A characteristic, which is not included in the connotation of a term but follows from it, is called the *proprium or property* of the term. It may be of two kinds. A property which follows from the connotation of the genus, is called the *generic property*. Feeling hungry or thirsty, mortality, etc. are characteristics which follow from animality. So they are the *generic property* of man. The property, which follows from the differentia of the term or from the whole connotation of the term, is called the *specific property*. Capacity to argue follows from rationality. So it is a specific property of man. Similarly, capacity to be civilised follows from the whole connotation of man. So it is a specific property of man.

A characteristic, which is neither included in the connotation nor follows from it, is called *accidens or accident*. Since connotation implies essential qualities, accident implies non-essential qualities of the term. Accident may be of two kinds. An accidental quality found in all the individuals of a class is called *inseparable accident* of the class, *e.g.*, bipedness is an inseparable accident of the class man. An accidental quality found in some of the individuals of a class is called *separable accident* of the class, e.g., blindness is a separable accident of the class man. In the case of an individual, an accidental quality is called inseparable, if it always belongs to the individual and is called separable, if it is sometimes present in the individual and sometimes not. Being to the south of India is an inseparable accident of Sri Lanka and having a Democratic Government is one of its separable accidents.

Relation of Opposition between Terms

Genus-species relation is a relation of subsumption or subordination. The species Man is subsumed under or subordinate to the genus Animal. So man is necessarily an animal. But two terms may be related by way of opposition so that one is necessarily opposed to the other. The co-ordinate species of a genus are related in this manner. They have different differentiae and naturally the fields of their applicability differ. Man and beast, beast and bird etc. are co-ordinate sub-classes under the same genus but they are opposed to each other. White and black, tall and short, hot and cold etc. are other pairs of opposite terms. Again, man and not-man, beast and not-beast, white and not-white, tall and not-tall, hot and not-hot etc. are also opposed to each other. Thus opposition of terms may be of two kinds. The relation of opposition which exists between terms like white and black, hot and cold, tall and short, etc., is called *Contrary opposition*. The relation of opposition which exists between terms like white and not-white, hot and not-hot, tall and not-tall etc. is called *Contradictory opposition*. When the entire extension of a term is divided into two sub-classes, the relation between them is contradictory opposition; but when the extension is divided into more than two classes, the relation between a pair of them is contrary opposition.

The following are the points of distinction between these two kinds of opposition :

(1) In the case of contrary terms if one is true, the other i necessarily false; but if one is false, the other is not necessarily true If we assert that white is true of something, then surely we cann assert black to be also true of it. Black is necessarily false of it. Bu if we assert that white is false of it, then black does not becom necessarily true of it. It may be of any colour other than white, e.g red or green or blue etc.

In the case of contradictory terms if one is true, the other false; and if one is false, the other is necessarily true. If we asse that white is true of something, then surely not-white is false of and if we assert that white is false of it, then surely not-white is tru This is so because not-white includes all colours other than whit i.e., red, green, blue, etc. So whatever be its colour, if it is not whi it is surely not-white.

(2) In the case of contrary terms we may take both of them be false of a thing in the field of their applicability. A coloured th may be neither white nor black. But in the case of contradict terms, we cannot assume that both of them are false of a thin the field of their applicability. A coloured thing cannot be said t

neither white nor not-white. It must be one of these, because whatever be its colour it is either the one or the other.

(3) In the case of contrary terms, both of them do not exhaust the entire extension of their genus, e.g., besides white and black, there are also other colours. But in the case of contradictory terms, both of them exhaust the entire extension of their genus. White and not-white include all the colours, because the term not-white means any colour other than white.

Classification of Terms

Classification of terms is the mental grouping of terms from a particular standpoint. The same term may be a member of different classes from different standpoints. Classification is necessary in order to expose the nature of terms so that their application may be faultless. If we know to which classes a term belongs, we get a clear idea of its meaning and gain capacity to use it correctly.

Logically, terms are classified in the following manner :

1. Single-worded or Simple and Many-worded or Composite terms

ଏକ ଶାବ୍ଦିକ ଓ ବହୁ ଶାବ୍ଦିକ ପଦ

If a term consists of one word only, it is called a single-worded or simple term, e.g., Ram, good, man, mortal.

If a term consists of more than one word, it is called a many-worded or composite term, e.g., the son of Dasaratha, a good noble prince, that man, undoubtedly mortal.

2. Univocal and equivocal terms

ଏକ ଅର୍ଥକ ଓ ବହୁ ଅର୍ଥବୋଧକ

If a term has only one meaning so that it is always used in the same sense, it is called a univocal term, e.g., tiger, yellow, almirah, triangular.

If a term has more than one meaning so that it can be used in different senses, it is called an equivocal term, e.g., crown (head-wear of a king and coin equivalent to five shillings), sound (sensation for ear and thorough), novel (a long story and new).

Some logicians are of opinion that this classification is of words and not of terms. Every term is used with only one meaning and it is necessary that the same meaning is retained throughout the argument. An equivocal word is equivalent to as many terms as it has meanings. In any case, an equivocal expression is the source of many fallacies and it is necessary to guard against it.

3. *Singular or Individual and General or Common terms*

ବ୍ୟକ୍ତିଗତ ଓ ସାମାନ୍ୟ

If a term indicates a single object or quality or collection, it is called a singular or individual term, *e.g.*, the Earth, this colour, Gandhiji, the University Library of Jyoti Vihar.

If a term indicates a class of objects or qualities or collections such that it can be used equally well for any member of the class, it is called a general or common term. It is the general or common name for all the members of the class, e.g., planet, colour, great man, library. The term planet may be used for the Earth or Mars or Jupiter or Saturn etc. Similarly, the term colour may be used for redness or blueness or greenness etc., and so on.

4. *Collective and Non-collective terms*

ସମଷ୍ଟିଗତ ଓ ଅସମଷ୍ଟିଗତ

If a term indicates a group or collection of similar things considered as one whole, it is called a collective term, e.g., library, army, a bunch of flowers, a batch of students.

The collective term is not applicable to the individuals in the group, but is applicable to the group itself. If a term does not indicate a group, but indicates either one individual or a class of individuals, it is called a non-collective term, e.g., the Ramayana, this soldier, flower, student. The Ramayana indicates one definite book. This soldier indicates a particular soldier. So these terms are not collective. Again, the term flower indicates a class of things such that it is applicable to any individual of the class of flower. The term student is applicable to any member of the student class. So these terms also are not collective. Non-collective terms indicating a class, e.g., flower, student, etc. are called distributive terms. So we may say that a distributive term is applicable to *any one of many*, but a collective term is applicable to *many in one*. Non–collective terms may be singular or general. Ram or this boy is a singular non–collective term, but boy is a general non–collective term.

Collective terms also may be singular or general. The University Library of Bhanja Vihar is a singular collective term, because it indicates one library only. But library is a general term, because it may be applicable to any collection of books.

5. Definite and Indefinite terms

If a term exactly indicates an individual or a class of things or qualities or collections so that no room for doubt remains in the sphere of its application, it is called a definite term, e.g., the Sun, this colour, the Library of Utkal University, all religions, no man, every girl.

If a term is such that the sphere of its application is not definite, it is called an indefinite term, e.g., some stars, one colour, a certain battalion, many girls.

6. Concrete and Abstract terms

If a term indicates an object or objects whether real or imaginary, it is called a concrete term, e.g., a man, this bunch of flowers, flying horses. Each of these objects is supposed to have some qualities. A man has the qualities of animality and rationality. This bunch of flowers may be taken as big. Flying horses have the qualities of flying and horseness.

If a term indicates not objects but a quality or qualities considered apart from the objects in which they are found, it is called an abstract term. Qualities are always found in objects but we may abstract them in thought, e.g., animality, rationality, bigness, capacity to fly, horseness.

Adjectives are considered as concrete terms. But their corresponding nouns are abstract terms. Rational, big, honest etc. signify the things qualified by them and not merely the qualities of rationality, bigness, honesty etc. So big is a concrete term; but bigness is an abstract term; honest is a concrete term, but honesty is an abstract term.

Concrete terms may be substantive or attributive. A man, this bunch of flowers, flying horse etc. are substantive terms and can be independently used either as subject or as predicate of propositions. Rational, big, honest etc. are attributive terms. Such terms can independently be used only as predicates and not as subjects of propositions, e.g., man is rational, this bunch of flowers is big. Attributive terms may, however, become parts of the subject term along with substantive terms, e.g., A rational being is capable of learning grammar. This big bunch of flowers is costly.

7. *Positive, Negative and Privative terms*

If a term implies the presence of a thing or quality, it is called a positive term, e.g., man, black, circular, natural, regular.

If a term implies the absence of a thing or quality, it is called a negative term, e.g., not-man, not-black, non-circular, unnatural, irregular.

If a term implies the present absence of a quality in a thing, which normally has the capacity to possess that quality, it is called a privative term, e.g., blind, barren, idle. An animal normally has eyesight. If an animal is deprived of eyesight, it is called blind. The term blind is inapplicable in the case of a table or a tree, because it never has eyesight. Blind is applicable in the case of a thing which normally possesses eyesight, but at present is deprived of it. So blind is a privative term. Similarly, deaf and barren are also privative terms, implying present absence of the capacity to hear and the capacity to produce respectively. But while these adjectives, which are concrete terms, are privative, their corresponding nouns, which are abstract terms, are negative. A blind animal may regain eyesight, if the cause of its blindness is removed, but the quality blindness cannot, in any sense, be said to regain eyesight. It simply implies absence of eyesight. So it is a negative term.

Determination of a term as positive, negative or privative depends on its meaning and not on its form. A term may appear as positive because of its form, but its meaning may show that it is really negative, e.g., Doubt is a negative term, because it means absence of knowledge or belief. Similarly, darkness is a negative term because it means absence of light. Some terms, again, appear as negative, but they are really positive, e.g., unpleasant is a positive term, because it means not only absence of pleasure, but also presence of suffering. Similarly, immoral means sinful or vicious and invaluable means very valuable. So these terms are positive. Similarly, the term sterile may appear as positive and the term unproductive may appear as negative, but their meaning shows that they are really privative terms.

It may be noticed that the contrary term of a positive term is also positive, but its contradictory is negative. Thus white and black are both positive terms, but not-white is a negative term. The terms like not-white, not-man etc. are sometimes said to be *infinite* terms, when they are used to denote anything except the corresponding positive terms. In this sense, their spheres of application become unlimited. Not-white, for example, in this sense would apply not only to the colours like redness, greenness, blueness, blackness etc. but also to morality, mind, soul, God,etc.

8. *Absolute and Relative terms*

If the meaning of a term is intelligible without any necessary reference to some other term, it is called an absolute term, e.g., man, tree, white, horse.

If the meaning of a term depends on and is derived from its relation to some other term, it is called a relative term, e.g., husband, friend, greater, north.

The term husband necessarily has a reference to wife. Both the terms derive their meaning from the same fact, i.e.,marriage. One cannot be thought of without the other. They are correlative of each other. A man is the husband only of his wife and a woman is the wife only of her husband. So man and woman are absolute terms, bu husband and wife are relative terms. Similarly, a man is the friend only of his friend. Two boys may be friends. But one boy, withou reference to another person, cannot be called a friend. In the same manner the bigger has reference to the smaller and the north has reference to the south. So these terms are relative.

It may be noted that positive terms like man, woman, white, black etc. are not relative terms. But negative and privative terms are relative,because they necessarily make a reference to the corresponding positive terms in order to be meaningful. So not-white blind etc. are relative terms.

9. *Connotative and Non-connotative terms*

A term having both denotation and connotation, i.e., wha indicates individuals and implies characteristics is called connotative. It has got a sphere of application which is determined by th characteristic or characteristics implied by it. Man, colour, the Sun the present Prime Minister of India, white etc. are considered a connotative terms. Man indicates the individuals Akbar, Alice Ram, Sita, etc. and implies the characteristics animality an rationality. So it is connotative. Colour indicates the differen colours like red colour, green colour, blue colour etc. and als implies the characteristic of being coloured. So it is connotative. Th Sun indicates the heavenly body which is seen shining during th day and implies the characteristic of being the source of heat an light. So it is connotative. Similarly, the present Prime Minister o Nepal indicates a definite individual and the term is applicable because of some characteristic, i.e., discharging the duties of hi office. White indicates the white objects and implies the characteristic of whiteness. So it is connotative.

A non-connotative term, on the other hand, signifies only a individual or only a characteristic but not both. Ram, Indira, Delhi whiteness, circularity etc. are considered to be non-connotative Ram, Indira, Delhi etc. are proper names which are applied t individuals not because of any characteristic, but for the sake of convenience in referring to them. Their sphere of application is not determined by any characteristic. So they are non-connotative. Whiteness and circularity, etc. indicate abstract characteristics, but have no sphere of application. So they are non-connotative. Thus these terms are said to have either denotation or connotation but not both.

According to some logicians, as Ram, Indira, Delhi etc. are names of concrete individual objects, without any criterion to limit their application, so also whiteness, circularity etc. are names of abstract qualities, without any criterion to limit their application. So in both the cases they have denotation, but no connotation.

In any case, the following kinds of terms are considered to be connotative :

(i) All kinds of general terms, e.g., man, tree, planet, library, husband, colour etc.

(ii) Singular concrete terms implying some characteristic, e.g., the Sun, the present Prime Minister of India, the highest mountain of the world, the author of the Gita, the Library of the Legislative Assembly of Orissa,etc.

(iii) All qualifying terms or adjectives, e.g., white, cold, blind, intelligent,etc.

The following kinds of terms are generally considered to be non-connotative :

(i) All proper names, e.g., Ram, India, Delhi, Himalaya, Vyasadev, Brahmaputra,etc.

(ii) All singular abstract terms, e.g., whiteness, circularity, truthfulness,etc.

The above is a general account of the classification of terms. Logicians, however, are not all agreed on several points. We may note here the difference of opinions of logicians on two questions.

character". England indicates a country and implies the qualities of that country. France indicates another country and implies the qualities of that country. So nobody mistakes England for France or France for England. The name of a boy or a girl is not written on his or her forehead. If the name John Smith does not suggest any quality to the mind of persons who know him, how do they recognise him ?

The course of the river Dart may change and the town Dartmouth may be at a place far away from the mouth of the river. But to anyone, who knows the town, the name must imply the qualities of the town, whatever they may be, and these, of course, will not include the quality of being situated at the mouth of the river Dart, though formerly this quality used to be included in them.

In any case, every proper name indicates an individual and implies some qualities to those who know the individual bearing this name. These qualities need not be in accordance with the Dictionary meaning of the name, but this does not warrant us to hold that proper names are non-connotative.

3. *Dr. P. K. Ray is of opinion that proper names are non-connotative so long as we do not know the individuals they name. They become connotative when we know the individuals of which they are the names. When a new class is formed in a college, the names are non-connotative to the teacher at first, but by gradual familiarity they acquire meanings and thus become connotative.*

4. *According to Bosanquet,* "A proper name has a connota*tion, but not a fixed general connotation.* It is attached to a unique *individual and connotes whatever may be involved* in his identity, or *is instrumental in bringing it before the mind."*

Criticism

Of all these views, generally Mill's view is considered to be correct. Carveth Read points out that the meaning, which proper names have, is "local or accidental" and this meaning cannot properly be called logical connotation. The same proper name may be given to different individuals with differing qualities. So all these individuals cannot be said to be the denotation of the one proper name. Nor can we say the common quality or qualities, even if these individuals have any, to be the connotation of the proper name. The denotation of the same proper name is different in different cases and in every case it indicates only one individual. This individual must have some qualities, but the name is not necessarily indicative of these qualities. Even after acquaintance different people may associate different qualities with the name. The boy named Ram may be considered to be good by one person and bad by another. So these qualities may be considered to be psychological connotation, but not logical connotation. According to Carveth Read "the peculiarities that distinguish an individual person are infinite." A complete enumeration of them is impossible. Again, it is arbitrary to take some of them to be the connotation and ignore the others. "So proper names have no assignable connotation." Whatever quality of the individual be taken as connotation, it is only its psychological connotation. So, logically proper names are non-connotative.

EXERCISE

1. Distinguish between :
    (a) Categorematic, Syncategorematic and Acategorematic words
    (b) Words, terms and names
    (c) Symbol and meaning.
2. Differentiate between :
    (a) Denotation and Connotation
    (b) Denotation and Extension
    (c) Connotation and Intension.

Q3. Examine critically the view that the denotation and connotation of a term vary inversely.

4. Write short notes on :

Genus, Species, Differentia, Proprium and Accident.

5. Explain the relation of opposition between terms and distinguish betwe Contrary and Contradictory terms.
6. Explain with examples the distinction between :
    - (a) Collective and non-collective terms
    - (b) Positive, negative and privative terms
    - (c) Connotative and non-connotative terms.
7. Write the logical character of the following terms :

    School, the highest peak of the world, the Sun, humanity, Akbar, circulari Kanika Library, mother, honest, unhappiness.
8. Write notes on :

    Summum genus, Infima species, Co-ordinate species, Non-verbal symbol Empty class.
9. Are abstract terms singular or general ?
10. Are proper names connotative or non-connotative ?

3

[illegible]

Definition

Nature and kind of Definition

Definition is an attempt to make the meaning of a term clear. This can be done in several ways suiting the term for which a definition is sought, the knowledge of the person seeking the definition, and the circumstances under which we are called upon to give the definition. So definition may be of different kinds. In any case, however, a definition is satisfactory, if it enables the questioner to use the term correctly.

If a little child asks what a parrot is, the best way to teach him the correct use of this term is to show him a parrot, if there be one. Children learn the meaning of many terms by seeing pictures. Such a method of defining a term is called *Ostensive Definition*. Ostensive definition, is non-verbal, because no words are necessary for such a definition, and denotative, because we point out to a member or some members of the denotation of the term. It is convenient to define terms like 'winking' or 'pinching' in this manner, since these acts can be done and shown. Similarly, red, sweet, cold,etc. also can be defined satisfactorily by only this method if proper objects are available.

Another way of defining terms, when things indicated by them are not nearby, but the questioner knows them, is to name the typical members of the denotation. In order to indicate the meaning of 'scripture', we may say, 'The Vedas, the Tripitakas, the Bible, the Koran, the Zend Avesta, the Granth Sahib, etc. are instances of scriptures'. Such a definition is verbal and denotative. We sometimes make use of extension instead of denotation, *e.g.*, pet animals are dog, cat, lamb etc.; eatable aquatic animals are fish, prawn, lobster, crab, oyster, etc. This process of defining terms is called *Extensive Definition*. Though such definitions very often serve the purpose of making the meaning of a term clear, it is not always possible to name the individuals of the denotation or the species of the extension exhaustively. The use of *etcetera* keeps it vague, because what other things are to be included or excluded cannot be known from such definitions. So such verbal definitions, though useful at the initial stage, ~~is~~ scientifically neither exact nor satisfactory.

Connotative or Connotational definition, which is the explicit statement of the connotation of the term, supplies a criterion by which the sphere of application of the term can be definitely determined. It is true that knowledge of the denotation of a term is helpful in determining its connotation and the knowledge of the connotation of a term gives the ability to identify the members of its denotation. But it is certainly easier to get the knowledge of the denotation with the help of the connotation than to get the knowledge of the connotation with the help of the denotation.

It is important to note that not every term has a denotation or an all admitted unchangeable fixed connotation. Different connotations may have the same denotation, *e.g.*, 'plane figure bounded by three straight lines' and 'closed rectilineal plane figure having three angles' indicate the same denotation, *viz.*, triangles. Proper names, *e.g.* Vishnu, Yamuna etc. have denotation but no connotation. Again empty classes, *e.g.*, winged horse, horned tiger etc. have connotations but no existing denotation. So one type of definition cannot satisfactorily deal with all types of terms and every type of definition has its own peculiar difficulties and limitations. Traditional Logicians have elaborately dealt with the Connotative Definition. A brief account of the Connotative Definition may be added here.

Nature of Connotative Definition

Connotative Definition is said to be the explicit statement of the connotation of the term. So in order to explain the meaning of a term, which is a word or a set of words, we take the help of another set of words. The term defined is called *definiendum* and the defining phrase is called *definiens*. The Definiendum and the Definiens are equivalent and indicate the same denotation. So one of them can be substituted for the other in any proposition and the meaning remains just the same. The definiendum, however, is an unanalysed term, whereas the definiens is an analysis of the meaning of the term. So the definiendum, which was not properly intelligible at first, becomes intelligible by the definiens. Of course, this is the case only when (i) the definiens is really equivalent to the definiendum and they unmistakably symbolize the same denotation and (ii) the words used in the definiens are rightly understood by the person seeking the definition. Traditionally, some rules have been formulated in order to fulfil both these conditions.

At least the first condition is satisfactorily fulfilled by the traditional formula that definition should be *per genus et differentiam.* By stating the genus we assimilate the definiendum to the class to which it belongs. All other classes being thus eliminated, the sphere of application of the term is partially indicated. To this the differentia or the differentiating characteristic or characteristics are added so that all cognate species under the same genus except the one indicated by the term are also excluded. So the definition definitely and correctly points out the sphere of the application of the term. By stating the genus, we have the process of assimilation and by stating the differentia we have the process of discrimination. By these two processes the exact denotation of the term is indicated and also the entire connotation of the term is stated, because the common and essential qualities are supposed to be nothing more than the generic and the differentiating characteristics. So connotative definition is also called per genus et differentiam definition.

Rules of Connotative Definition

1. The definiens should state only the entire connotation of the definiendum, neither more nor less.

The connotation of the term comprises the characteristics of its genus and its differentia. So this rule is the same as the rule *per genus et differentiam*. It fulfils the requirement that the definiens should be the analysed equivalent of the definiendum.

e.g., Man is a rational animal or Man is that which has animality and rationality or Humanity is animality and rationality.

Triangle is a plane figure bounded by three straight lines or triangle is a closed rectilineal plane figure having three angles.

(*a*) If we violate this rule by stating more than the connotation, the additional quality being either an accident or proprium, the definition is fallacious. The fallacy is called *Overcomplete definition*.

e.g., Man is a biped rational animal.

Man is a rational animal capable of feeling pleasure and *pain.*

Triangle is a plane figure bounded by three straight lines, *which can be drawn* on the blackboard.

Triangle is a closed rectilineal plane figure having three *angles, the sum of* which is equal to two right angles .

When the additional quality over the connotation is proprium, the fallacy is also called *Redundant definition.* The additional quality is redundant or superfluous, because it is already implied in the connotation. 'Man is a rational animal capable of feeling pleasure and pain' and 'Triangle is a closed rectilineal plane figure having three angles the sum of which is equal to two right angles' are redundant definitions.

(*b*) If we violate this rule by stating less than the connotation, the definition is fallacious. The fallacy is called *Incomplete definition*, because a part of the connotation is left unstated.

e.g., Man is an animal.

Man is rational.

Triangle is a plane figure.

Triangle is that which has three angles.

(*c*) If we violate this rule by not at all stating the connotation and mentioning some accidental quality in the definition, the fallacy is called *Accidental definition.* It is merely a description of the term and cannot properly be called a Definition.

e.g., Man is a featherless biped.

Triangle is a diagram in the shape of a pyramid.

2. *The denotation of the definiens should be exactly the same as that of the definiendum.*

This rule secures the requirement that the definiendum and the definiens can mutually be substituted for each other in order to indicate the same individual or individuals.

e.g., Man is a rational animal.

Triangle is a plane figure bounded by three straight lines.

These definitions are justified by this rule, because Man indicates Akbar, Alice, Ram, Sita,etc. and rational animal also indicates the same individuals. The definiens—plane figure bounded by three straight lines—indicates all and only those figures which can be named Triangle.

(*a*) If the denotation of the definiens is wider than that of the definiendum, this rule is violated. The fallacy is called *Too wide definition.*

e.g., Man is an animal.

Triangle is a figure.

(*b*) If the denotation of the definiens is less than that of the definiendum, the fallacy is called *Too narrow definition.*

e.g., Man is a civilised rational animal.

Triangle is a plane figure bounded by three equal straight lines.

3. *The definiens should not contain a part or whole of the definiendum itself or any word derivable from or definable by the definiendum.*

This rule is concerned with the purpose of the definition which is to make clear the meaning of the definiendum so that it can be correctly used. This purpose cannot be served if the definiendum in any form is made use of in the definiens. The following definitions are fallacious, since they violate this rule.

Man is a human being.

Triangle is a triangular figure.

India is the country of the Indians.

Virtuous damsel is a damsel who possesses virtues.

Human and *triangular* are words derived from man and triangle respectively. So they cannot be understood if the meaning of the terms *man* and *triangle* is not known. Indian is definable only with the help of India. Similarly, the above definition of virtuous damsel is useless, because it does not clarify the meaning of damsel and virtue. The fallacy in these cases is broadly called *Circular Definition.*

Synonymous definition is also considered fallacious, since without giving any analysis of the definiendum, it gives only a synonym of it. If the connotation of the synonym of the definiendum is known, then such a definition does serve the purpose to some extent. But it cannot be said to give an Analytical definition. The connotative meaning is not brought out by the definition itself.

e.g., Homosapien is a human being.

Donkey is an ass.

Monkey is an ape.

Dog is a hound.

4. *The definiens should be clearer than the definiendum and should not contain any obscure or figurative expression.*

This rule also is concerned with the purpose of definition. A definition is sought in order to know the exact meaning of a term. This purpose is not at all served if the definiens is more obscure than the term itself. Further, by figurative expression we may be giving a hint at the meaning poetically, but the exact meaning is not made clear thereby. The following definitions violate this rule and so are fallacious.

Net is a reticulated fabric decussated at regular intervals with interstices between the intersections.

Girl is a perpendicular biological phenomenon in short skirt.

Fluency is an exuberance of verbosity.

In the above examples we commit the fallacy of *Obscure definition.*

Camel is the ship of desert.

Lion is the king of beasts.

Necessity is the mother of invention.

Ignorance is a blind guide.

In the above examples we commit the fallacy of *Figurative definition.*

5. The definiens should not be negative, if it can be affirmative.

The definition should state what the term means. A negative definiens states what the term does not mean. So the meaning of the definiendum is likely to remain vague. The violation of this rule leads to the fallacy of *Negative definition.*

e.g., Right is not wrong.

Gas is that which is neither solid nor liquid.

Tranquillity is the absence of unrest.

Good is the opposite of bad.

When the definiendum is a negative or a privative term, th definition is bound to be negative. Negative definitions are als useful where an affirmative definition is not possible.

e.g., Darkness is the absence of light.

Orphan is one deprived of father and mother.

Bachelor is an unmarried male.

Limits of Connotative Definition

Giving Connotative definition is not possible in the following kinds of terms :

(*i*) Summum Genus cannot be defined, because it has no Genus, e.g., Reality.

(*ii*) Proper names have no connotation. So they cannot be defined, *e.g.,* Vishnu, Yamuna.

(*iii*) Terms implying elementary qualities cannot be defined, because it is not possible to state the differentia, e.g., pleasure, pain, sweetness. One can have the experience of these and know them, but cannot give their connotative definition.

(*iv*) Terms indicating things without a second cannot be defined because they cannot be brought under any class, *e.g.,* space, time, air.

Distinction between Connotative Definition and Description

Traditionally, a distinction is made between Definition which states the connotation of the term and Description which states some characteristics of the objects indicated by the term not necessarily the connotation. This has led to the opinion that terms are defined but objects are described. Distinction of definition from description on this ground, however, is untenable. Terms are used to refer to things, whether existent or imaginary. We talk using terms only in order to talk about things. So both definitions and descriptions may be said to be either of terms or of things indicated by them.

If, however, it is agreed that definition is the statement of the connotation, whereas description is the statement of some characteristics which may be accident, proprium and sometimes, part of the connotation, then it may be said that definition is methodically determined whereas description is not so determined; definition is scientific whereas description is popular; definition is expected to be universally accepted, but description differs from person to person; definition depends on reason whereas description depends on imagination and so on. The aim of definition is to make the meaning of the term clear and so it enables us to identify objects denoted by it. Thus an island may be defined as a small piece of land surrounded by water, and with the help of this we can identify island on a map. Descriptions also enable us to identify objects, but all descriptions are not of equal value. The value of description in identifying objects depends on the characteristics stated in it. Giving connotative definition of some of the terms is not possible but some sort of a description can be given in all cases. Wherever giving connotative definition is possible, giving a description is also possible, but wherever giving a description is possible, giving connotative definition may not be possible. Man may be defined as a rational animal and may be described as a featherless biped with broad nails. Air cannot be defined connotatively, but it can be described as that which we breathe.

EXERCISE

1. Explain the different kinds of definition with suitable examples.
2. What is the nature of Connotative definition ? Explain its rules.
3. Is it possible to define all terms connotatively ? What alternative ways are there in the cases where connotative definition is not possible ?
4. Distinguish between :
    (a) Connotative definition and Description

(b) Connotative definition and Denotative definition
(c) Non-verbal denotative definition and Verbal denotative definition.

5. Explain and illustrate the following fallacies :
   (a) Overcomplete definition
   (b) Incomplete definition
   (c) Redundant definition
   (d) Accidental definition
   (e) Too wide definition
   (f) Too narrow definition
   (g) Circular definition
   (h) Synonymous definition
   (i) Obscure definition
   (j) Figurative definition
   (k) Negative definition.

6. Explain the following :
   (a) *Per genus et differentiam*
   (b) Processes of assimilation and discrimination
   (c) Terms having no denotation
   (d) Terms having no connotation
   (e) Terms having no affirmative definition
   (f) Ostensive definition
   (g) Extensive definition.

7. Test the following definitions :
   (a) Beast is an animal.
   (b) A modern lady is a woman who puts on sleeveless blouse and goggles and wears her wrist–watch on her right hand.
   (c) Dictator is a man who dictates and writer is a man who writes.
   (d) Triangle is a plane figure bounded by three sides, the sum of the angles being two right angles.
   (e) Science is what is not an art.
   (f) Knowledge is power.
   (g) Intellect is the eye of the soul.
   (h) Teachers are those who teach.
   (i) Sovereign is king.

(j) A periphrasis is a circumlocutory cycle of oratorical sonorosity circumscribing an atom of ideality lost in verbal profundity.

(k) Spinster is an unmarried woman.

8. Give your comments on the following statements :

(a) An overcomplete definition is a too wide definition

(b) Every term must have denotation and connotation.

(c) Negative definitions are absolutely useless.

(d) Terms having no fixed connotation are meaningless.

4

Logical Division

Nature of Logical Division

Logical division is the analysis of the extension of term. It is splitting up of a genus into its constituent species from a particular standpoint. The class which is divided is called *totum division,* the subclasses into which it is divided are called *membra dividentia* and the standpoint from which the division is made is called *fundamentum divisionis*. The same class can be divided differently from different standpoints. Man can be divided into male and female from the standpoint of sex. It also can be divided into tall, short and medium-sized from the standpoint of height.So unless the *fundamentum divisionis* is fixed, the division of classes into some subclasses cannot be a proper logical division.

Logical division is closely connected with the process of classification. In classification we begin with a number of individuals, note their characteristics and systematically group them in as many classes as possible in accordance with the points of similarity and difference. Again these classes are subsumed under higher classes and those classes under still higher classes and so on. Every science begins with a classificatory stage. Classsification is also useful in our daily life. A fruit-seller buys a basketful of mangoes and classifies them as big, small and medium-sized, so that he can sell at different rates. A grocer classifies all the items of his shop as oil,pulses, spices, vege tables,etc. so that he may assign different stalls to these things in his shop. It may be noted that while classification begins with the lowermost classes and proceeds to higher classes division begins with a higher class and proceeds towards the lowermost classes. One starts from the bottom, the other from the top, but both are concerned with the systematic arrangement of things with a view to having a clear picture of the meanings of interconnected terms.

Logical division is also closely connected with connotative definition. It is said that in defining we divide and in dividing we define. In order to define the term man, we state its genus animal and its differentia rational. This necessarily implies that the class animal can be divided into two subclasses from the standpoint of having or not having rationality, *i.e.*, man and not-man. So definition involves division. Again, when we divide triangle into equilateral, isosceles and scalene taking into consideration the equality of sides, the definitions of these terms are evident, since their genus is triangle and the differentiae are having three equal sides, having two equal sides, and having unequal sides respectively. Thus division involves definition. It should be noted, however, that neither the division of a term involves *its* definition nor its definition involves *its* division. The fact is that the division of the genus involves the definition of the species and the definition of the species involves the division of the genus. When the term animal is divided, the term man is defined and when the term man is defined, the term animal is divided.

From all what has been said here and in the previous chapter, it is clear that definition, description, division and classification are all undertaken in order to make the meaning of terms clear. Connotative definition and description deal with the qualitative aspect of the terms while denotative definition, division and classification deal with their quantitative aspect. Denotative definition indicates the members of the denotation. So class terms having a large number or an infinite number of members cannot be exhaustively dealt with. Division circumscribes this difficulty by indicating the extension instead of the denotation. Classification is nothing b division in the reverse order.

Logical Division should be distinguished from Physic Division and Metaphysical Division.

Logical Division is always of a class into its subclasses from particular standpoint. So when a class is divided into individuals o an individual into its parts, the division is not logical. Thus when ma is divided into male and female from the standpoint of sex, it is logical division. But when the class man is divided into Ram, Akbar, Sita, Savitri,etc., it is said to be enumeration. Similarly, when Ram, the individual man, is divided into his head, trunk, hands, legs etc., i is said to be partition. Both enumeration and partition can be broadly said to be physical division.

A class or individual is also characterised by some qualities. When we make an analysis of these qualities, it is called metaphysical division or qualitative analysis of the term. Evidently such a division is also different from logical division, which must be of classes into subclasses. Thus the class man can be logically divided into subclasses like tall man, short man and medium–sized man, but not into tallness, shortness and medium–sizedness nor even into animality, rationality and bipedness. Similarly, the analysis of the qualities of the individual Ram into handsomeness, honesty, sincerity etc. cannot be called a logical division. Such a division of a class or an individual is metaphysical division or analysis.

Rules of Logical Division

1. The term to be divided must be a general term and the terms to which it is divided must also be general terms.

This rule is evident from the very definition of Logical division. When class terms are divided into subclasses, the division is called logical. So the term to be divided is a class and the terms to which it is divided are also classes. Violation of this rule leads to either the fallacy of *Physical division* or the fallacy of *Metaphysical division.*

e.g. India is divided into Orissa, Bihar, West Bengal, Andhra Pradesh, etc.

Indian Parliament is divided into Loka Sabha and Rajya Sabha.

A certain quantity of water is divided into oxygen and hydrogen.

One's life is divided into childhood, youth and old age.

In all these cases we have committed the fallacy of *Physical division* because in each case the term to be divided is a singular term and its constituent parts have been separately considered by the above process of division.

Man is divided into Akbar, Alice, Ram, Sita etc.

River is divided into Mahanadi, Brahmani, Vaitarani etc.

Ocean is divided into Pacific, Atlantic, Indian, Arctic and Antarctic.

In all these cases also we commit the fallacy of *Physical division*, because though the terms divided are classes, the sub-divisions are not classes. It enumerates the individuals making up the class.

Man is divided into animality, rationality, capacity to argue, etc.

Glass is divided into transparence, brittleness, smoothness, hardness, etc.

Akbar the Great is divided into his honesty, sincerity, bravery, integrity, tactfulness, etc.

In all these cases we commit the fallacy of *Metaphysical division,* because whether the terms are singular or general they have been divided into their qualities.

2. The name of the class divided must be applicable to each of the subdivisions.

All subclasses of a higher class belong to that class. So in every logical division the sub-divisions may take the name of the class. Thus when the class man is divided into the subclasses, tall, short and medium-sized, all these subdivisions being sub-divisions of th class man, we can tell them to be tall man, short man and medium sized man. Similarly, when man is divided into rich, poor and middl class, we may apply the term man to each sub-division and say ric man, poor man and middle class man. If a singular term be physicall divided into its parts or metaphysically divided into its qualities, it i not possible to apply the term to each of the parts or qualities. Th leg or bipedness is not man. So when this rule is not satisfied, th division is not logical. It must have been either a physical or a metaphysical division.

It may be noted that even when this rule is satisfied, the division still may be fallacious and not logical because of the violation of some other rule. When a class term is divided into the members of its denotation, the class term sometimes may be applicable to the members of the denotation, *e.g.,* Ocean is divided into Pacific Ocean, Atlantic Ocean, Indian Ocean, Arctic Ocean and Antarctic Ocean. So here the term is applicable to each sub-division. But still the division is fallacious because logical division is concerned with extension and not with denotation. In logical division the class should be divided into sub-classes and not into members. It is immaterial whether a class has many members, one member or no member. But as long as we divide a class into subclasses, the division is logical. We may divide the class student of a particular college from the standpoint of height into the sub-classes; student above six feet, student between six feet and five and a half feet, student between five and a half and five feet, and student below five feet and discover that the 1st subdivision is empty, the 2nd subdivision has only one member, the 3rd subdivision has 90% of the denotation and the 4th subdivision has the remaining members. But since the division is of a class into its subclasses, it is logical. But if we divide this class into individuals making up that class, it is enumeration of members or physical division.

3. Logical division should have at a time only one fundamentum divisionis or the principle of division.

When this rule is observed, the subclasses become well-defined, since they are formed by noting the presence or absence or presence in varying degrees of one particular attribute. Thus the term man can be divided into two subclasses like honest and dishonest, so that one subclass is characterised by honesty whereas the other subclass lacks this characteristic. There is no possibility of some members of one class becoming also members of the other class. The subclasses are clearly definable. Similarly, we may divide the class man into tall, short and medium-sized by noting the varying degrees of height and fixing up a criterion to determine these subclasses. Thus we get a clear idea of the extension of the term divided. But when we take more than one *fundamentum divisionis*, that is, when we divide the class by adopting several principles of division, the subclasses are not clearly demarcated. Thus if man be divided into rich, tall and honest, we have difficulty in classifying the tall rich men, tall honest men and rich honest men in these subclasses. The fallacy arising from the violation of this rule is called the fallacy of *Cross division*. The division of table into round, wooden and dining also illustrates this fallacy.

4. The subdivisions should not overlap, but should be mutually exclusive.

In order to have a clear conception regarding the extension of a term, it is necessary that the subclasses are distinguishable from one another. If some members of one class also become the members of some other class, it cannot be said that the term has been really divided into subclasses. The subclasses should fall apart. So if they are not mutually exclusive but overlap one another, the very purpose of division is lost.

This rule is the usual counterpart of rule 3. It prescribes only what should be the nature of the subdivisions of a logical division, whereas the previous rule is about the principle of division. The violation of rule 3 generally leads to the violation of rule 4. The fallacy which arises by the violation of rule 4 is given the name — *Overlapping division*. But since the fallacy of *Cross division* usually leads to the fallacy of *Overlapping division*, the same examples illustrate both the fallacies. Thus the division of man into rich, tall and honest,or table into round, wooden and dining illustrates also the fallacy of overlapping division. Some rich men may be tall or honest, some tall men may be rich or honest, some honest men may be rich or tall. Again some men may have all these three characteristics. So the subclasses are overlapping, not exclusive.

In some cases, however, a division may commit the fallacy of cross division without committing the fallacy of overlapping division, *e.g.*, triangles are divided into equiangular, isosceles and scalene.

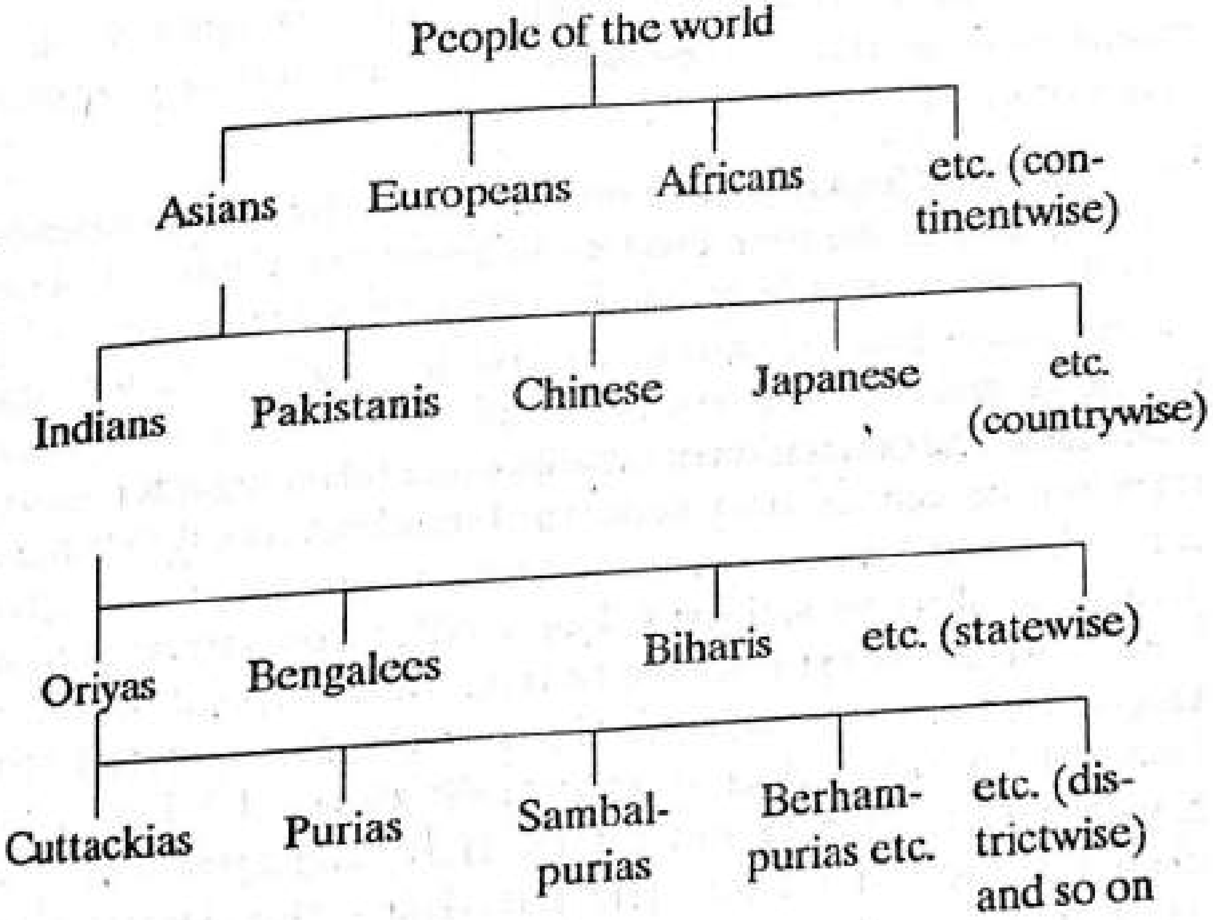
5. In logical division all the subdivisions over which the term extends should be stated and no subdivision over which it does not extend should be stated.

The aim of logical division is to give us an exact idea regarding the extension of the term divided. So unless every subclass of the term divided be mentioned, the extension remains incomplete. All the subclasses must be collectively exhaustive of the class divided and no member of the class can be omitted when it is divided into subclasses. The denotation of the subclasses taken together should, therefore, be same as the denotation of the class divided. When this is not the case, *i.e*, when one or more subclasses are omitted, the division is fallacious and the fallacy is called *Too narrow division*. Thus, if we divide the class Indian from the standpoint of mother tongue into Oriya, Bengali, Bihari and Telugu, we commit the fallacy of *Too narrow division*, because the classes of Indian people having mother tongues other than these languages have been omitted in this division. Similarly, if rectilinear closed plane figure be divided into triangle and quadrilateral the fallacy committed is *Too narrow division*, since the subclass polygon is omitted.

Besides stating all the subclasses of a class,if we state as a subclass something not properly belonging to the class, then this subclass is one over which the term does not extend and the division is fallacious. Here the denotation of the sub-classes taken together is more than the denotation of the class. The fallacy committed is called *Too wide division.* Thus if we divide closed rectilinear plane figure into triangle, quadrilateral, polygon and circle, we commit the fallacy of *Too wide division* because circle is not a rectilinear figure.

6. In a continued division, at each stage the class should be divided into its proximate subclasses in accordance with the original fundamentum divisionis.

Logical division is done in order to have a clear idea regarding the different varieties of subclasses that come under a general class. Thus the people of the world can logically be divided from the standpoint of habitation thus :



If the intermediary steps are omitted and a class is divided into remote subclasses, the division is considered fallacious and the fallacy is called *Division by a leap.*

Limits of Logical Division

The following kinds of terms cannot be logically divided :

(i) Infima species cannot be logically divided. Since it is th lowermost clsss, it cannot be divided into classes lower tha it.

(ii) All kinds of singular terms cannot be logically divide because they do not signify classes.

(iii) Since logical division is an analysis of extension, any ter having no extension cannot be logically divided.

EXERCISE

1 . What is the nature of Logical division ? Show the relation of logical divisio with classification and connotative definition.

2. Explain with examples the distinction between Logical, Physical and Metaphysical division.

3. State and explain the rules of logical division.

4. What is *fundamentum divisionis* ? Why is it necessary to have a single *fundamentum divisionis* in every case of logical division ?

5. Explain and illustrate the following fallacies :

   (a) Cross division

   (b) Overlapping division

   (c) Too narrow division

   (d) Too wide division

   (e) Division by a leap.

6. What is division by dichotomy ? Explain and examine its advantages and disadvantages.

7. What is the purpose of Logical division ? Is it possible to divide logically every term ?

8. Test the following division :

   (a) Flower into petals, stamen, pollens and stem.

   (b) Rose into colour, shape, size, fragrance and beauty.

   (c) Man into educated, educationists and politicians.

(d) Coin into gold, silver and brass.

(e) Asian people into Oriya M. L. As and others.

(f) Triangle into right-angled, obtuse-angled, acute-angled and equiangular.

(g) School into Oriya, English and Telugu.

(h) Letter into vowel, consonant and digit.

(i) Book into prose, poetry and story.

(j) Room into walls, floor and ceiling.

(k) Food into fish, flesh, fowl and good red-herring.

(l) People into men, women and children.

(m) Life into eating, drinking and being merry.

(n) Man into bachelor, married and widower.

5

Proposition

Nature of Proposition

There is a world of things around us. Innumerable events happen in the world. These are facts which simply are. They cannot be said to be true or false. But when we think about any of these facts, our beliefs or disbeliefs may be either true or false. The term 'judgement' is used for each of our opinions on facts at the mental stage. A judgement is true when it is in harmony with facts and it is false when it is in disharmony with facts. Looking at a tall boy I may come to form in my mind a judgement about him that he is more than 6 ft. in height. If measurement shows that he is in fact more than 6 ft. tall, then my judgement about his height is true, otherwise it is false. A judgement is said to be the outcome of the combination of at least two ideas. The idea of the subject is combined with the idea of the predicate and the result is the judgement.

Proposition is the expression of a judgement. It is a description or an assertion of some facts. So it must be either true or false. The facts about which the assertion is made determine its truth or falsity. A proposition may be stated in a number of different ways. Each way of stating the proposition is a sentence. The sentences may be different in form, may be in different language, but as long as their meaning remains the same, they are only different ways of stating the same proposition. Thus, for example : Ram killed Ravana, Ravana was killed by Ram, Ram was the slayer of Ravana and *Ramah Ravanam jaghana* are four different sentences, but they express the same proposition. Sometimes the same sentence may

proposition. In the former case 'good' is predicated of the subj Ram. In the latter case the proposition states that Ram and Sita a related by way of marriage.

A compound proposition contains two or more compone propositions. It may be either composite or conjunctive. Conjun tive proposition is the conjoint assertion of two or more ind pendent propositions, e.g., Ram goes to Calcutta and Hari goes t Bombay. Composite propositions may be either hypothetical o alternative or disjunctive. In hypothetical proposition an assertio is made under some condition, e.g., *If he has laboured hard, he wi surely pass the examination.* In alternative proposition it is asserted that of several alternatives at least one is true, e.g., *Either th triangle is equilateral or isosceles or scalene.* In disjunctive proposition it is asserted that the component propositions cannot simultaneously be true, e.g., *It is not the case both that you spend every pie you get and that your saving increases by leaps and bounds.*

A general proposition is one which asserts that one class is wholly or partially included in or excluded from another class, e.g., All men are mortal; Some men are blind; No men are quadruped; Some men are not blind.

The above account of proposition is the modern view. The traditional logicians used to give a different analysis and classification of propositions. They used to consider a grammatically simple sentence to be equivalent to a logically simple proposition; an individual was taken as a class having one member; and all simple propositions were supposed to be statements of class inclusion or class exclusion. Every simple proposition, according to them, must have one subject, one predicate and one copula. The copula being a form of the verb 'to be'. All sentences which were not in this form were required to be transformed, even at the risk of distortion, into logical propositions having clearly these three distinct parts, i.e., subject, predicate and copula. Subject is that of which something is said; predicate is that which says something about the subject; and copula is that which indicates that the subject and the predicate are conjoined. The logical subject is generally identical with the grammatical subject of the sentence, but the logical predicate differs from the grammatical predicate, because the copula must be taken out from it and if necessary, some changes in the wording are to be made. The sentence 'Ram is good' is also a logical proposition since the three parts are distinctly stated here. 'Ram' is the subject, 'good' is the predicate and 'is' is the copula. Ram marries Sita is not a logical proposition according to the traditional logicians. The corresponding logical proposition is 'Ram is a person who marries Sita' or 'Ram is married to Sita' where the predicate is either the noun 'a person who marries Sita' or the adjective 'married to Sita'. According to this view, Ram killed Ravana and Ravana was killed by Ram should be differently reduced to logical forms since the subjects are different. Similarly, No cows are horses and No horses are cows are two distinct propositions though one is implied by the other.

In this connection it may be noted that the traditional logicians recognised only subject-predicate propositions and did not consider relational propositions as of a different kind. They reduced relational propositions into subject-predicate-copula form before treating them in logic.

Nature of Logical Copula

According to the traditional logicians Copula is an essential part of every elementary logical proposition. It is the joining link between the subject and the predicate. A proposition is the result of the combination of the subject term with the predicate term. If there be no Copula, there is no connecting link between these two terms and consequently there is no proposition. Copula, of course, is not a term; it is the symbol of the relation between the terms.

The transformation of ordinary sentences of the language into logical propositions with the three distinct parts was considered necessary in order to facilitate argument. The nature of Copula, therefore, has been accordingly determined.

1. It is agreed that the Copula should be a form of the verb 'to be', i.e., it should be is, am, are etc. If we have two propositions like S is P and P is Q, it is easy to infer that S is Q. But if we have two propositions like S eats P and P drinks Q, it is difficult to draw a conclusion if any is involved. So whatever be the verb of a sentence, its verb character is included in the predicate, the Copula remaining purely a symbol of relation between the subject and the predicate. Thus S eats P is transformed into S is an eater of P. Lion eats man is transformed into Lion is a man-eater or Lion is an animal who eats man. Some men drink wine is transformed into Some men are persons who drink wine and so on.

2. There is difference of opinions between Mill and other logicians regarding the tense of Copula.

According to Mill, Copula may be of any tense—past, present or future. Since it indicates the relation between the subject and the predicate, Mill is of opinion that it should also indicate the time of the existence of this relation.

According to Hamilton, Mansel, Fowler etc., Copula should always be of the present tense. Sentences are transformed into propositions for the sake of convenience in argument. If all the premises be in one tense, the tense of the conclusion is easily determined. But if one premise be in past tense and another in future tense, we cannot easily determine the tense of the inferred conclusion. This difficulty is avoided if the Copula be always in the present tense. It is possible to change sentences about past or future events into propositions with a Copula of present tense, but sentences about present events cannot be changed into propositions wit a Copula of past or future tense. Ram was the eldest son o Dasaratha can be changed as Ram is a person who was the elde son of Dasaratha. But Ram is a student of I. A. class cannot b changed into a proposition having a Copula which is of past or futur tense. Further, the Copula being a symbol of relation between th subject and the predicate does not admit of variation in time. Logi is concerned with validity which does not vary from time to time, but is valid or invalid for all time. Time element has no place in Logic. So the Copula should be made free from the element of time, by transferring the time element to the predicate. Therefore, it is generally accepted that the Copula should be always, is, am, are, etc., i.e., it should be in the present tense. Thus, S was P is transformed into S is what was P; S will be P is transformed into S is what will be P and so on.

3. There is also difference of opinions among logicians regarding the quality of Copula. The question here is if there be any negative particle, viz., 'not' should it be a part of the Copula or should it be a part of the predicate ?

Hobbes is of opinion that Copula should be always affirmative. Copula indicates that there exists a relation between the subject and the predicate and consequently we get a proposition. If it be negative, it would mean that there is no relation between the subject and the predicate and so there is no proposition. According to Hobbes, therefore, the negative particle, if any, should be included in the predicate. Thus he would reduce the proposition'S is not P' into 'S is not-P', 'Ram is not intelligent' into 'Ram is not-intelligent' or 'Ram is unintelligent.'

It is pointed out by other logicians that a negative relation is not the absence of any relation. Men may be either intelligent or unintelligent. So the relation between some men and intelligence may be either positive or negative. But trees cannot be said to be intelligent or unintelligent. So there is no relation between them. No significant proposition can be formed by taking trees as subject and intelligent or unintelligent as predicate. Since relation can be either positive or negative, Copula which is the symbol of relation should be also either positive or negative. Therefore, the negative particle, if any, should form a part of the Copula. Thus in the proposition S is P, 'is' is the Copula and in the proposition S is not P, 'is not' is the Copula.

4. Logicians are divided in their opinions with regard to the modality of the Copula also. The question here is, if there be any sign of modality, e.g., must or may etc. should it be a part of the Copula or should it be transferred to the predicate ?

Some logicians, e.g., Fowler, are of opinion that such particles should be included in the predicate, the Copula remaining only is or am or are or is not or am not or are not etc.

Other logicians are of opinion that transference of the sign of modality to the predicate is unnecessary circumlocution. There is no difficulty in inference even if the sign of modality be included in the Copula, since from a proposition which is certain it is possible to infer less certain or probable propositions; but from a proposition which is probable, it is not possible to infer any proposition which is certain. From propositions involving 'must' we may infer propositions involving 'may' but the reverse is obviously inadmissible. So it is accepted that 'S must be P' need not be changed to 'S is what must be P'. Similarly, 'S may be P' need not be changed to 'S is what may be P'. The logical form of 'Women must have given birth to children in order to be called mothers' is 'Women must be persons who have given birth to children in order to be called mothers'. The Copula here is 'must be'. The logical form of 'Some children may not have attended the meeting' is 'Some children may not be persons who have attended the meeting'. Here the Copula is 'may not be.'

From the above discussion, we conclude that the Copula should be a form of the verb 'to be'. It should be in the present tense. The sign of negation and the sign of modality, if any, should be a part of the Copula.

Classification of Propositions

Generally, propositions are classified from the following standpoints :

(*i*) According to composition—Simple and Compound.

(*ii*) According to quality—Affirmative and Negative.

According to quantity—Universal and Particular.

(iii) According to relation—Categorical and Conditional

(iv) According to modality—Necessary, Assertory and Problematic.

(v) According to significance or import—Verbal and Real.

(vi) According to

(i) Traditionally a proposition is called simple if it expresses a relation between one subject and one predicate, e.g., S is P, S is not P, Ram is good, Hari is not bad, All men are mortal, Some men are not intelligent.

If a proposition expresses a relation between more than one subject with one predicate or one subject with more than one predicate or more than one subject with more than one predicate, it is called compound, e.g., S and T are P; S is P and Q; S is P and T is Q; Neither S nor T is P. Neither S is P nor T is Q; Both men and birds are biped; Ram is neither intelligent nor hard working; The elder brother is religious but the younger is not.

Compound proposition is analysable into more than one simple proposition. Of the above examples of compound proposition each one can be analysed into two simple propositions. If the constituent propositions of a compound proposition are all affirmative, the compound proposition is called Copulative, e.g., S and T are P=S is P and T is P.

If the constituent propositions of a compound proposition are all negative, the compound proposition is called Remotive, e.g., S is neither P nor Q=S is not P and S is not Q.

There are some propositions which appear like simple, but at least two propositions are involved in the meaning of each of them. Such propositions are called Exponible. Two kinds of Exponible propositions have drawn the attention of logicians. They are called Exclusive and Exceptive. 'Only S is P' or 'S alone is P' or 'None but S is P' is an illustration of Exclusive proposition. It means that 'No non-S is P' and, 'At least some S is P'. It is not equivalent to 'All S

Organisation, A dog is barking in the street. Thus a singular proposition has a singular term for its subject.

A singular proposition may be universal or particular. It is universal when the subject is a definite singular term. The first three propositions in the above examples are universal, because in each of these cases the denotation of the subject term is confined to one individual only and the predicate is asserted of the entire denotation.

A singular proposition is particular, when the subject is an indefinite singular term. The last two propositions in the above examples are particular, because in each of these cases, an indefinite member of the denotation of the subject is said to be related to the predicate. Since 'some' means at least one, such propositions are same as propositions having 'some' meaning some one.

(iv) Traditional Logicians divided propositions from the standpoint of relation into Categorical and Conditional. The Conditional Propositions, again, were divided into Hypothetical and Disjunctive.

A Categorical Proposition is one which is asserted absolutely or unconditionally, e.g., S is P, S is not P. All men are mortal. Some men are not selfish. The boy is intelligent.

A Hypothetical Proposition, on the other hand, is one which connects a consequent with a condition. It is of the form "If .... then .....". Here something is asserted under certain explicit condition, e.g., If X is Y, then S is P; If M is not N, then S is not P. The boy is intelligent, if he can solve this intricate problem. In some cases, if a man meets with an accident, he dies.

A Disjunctive proposition, according to the Traditional Logicians, is one which makes alternative predication. It is of the form "Either.... or ... ". It is conditional, because the assertion of any of the alternatives depends on the denial of the others, e.g., A is either B or C. The boy is either intelligent or diligent. Most people of this locality are either farmers or workers in the Factory.

The Modern Logicians point out that a proposition with alternative predication cannot be properly called a Disjunctive Proposition. So they name such propositions as Alternative. A Disjunctive proposition according to them is of the form "Not both .... and. ....". It asserts that the disjuncts cannot be simultaneously true, e.g., It is not the case both that A is B and also C is D. It cannot be the case that a man fought with Akbar the Great and also is a member of the Orissa Legislative Assembly at present. The alternants of an Alternative proposition cannot both be false. So the falsity of one alternant implies the truth of the other, while the disjuncts of a disjunctive proposition cannot both be true. So the truth of one implies the falsity of the other.

According to the Modern Logicians the traditional classification of propositions into categorical, hypothetical and disjunctive is clumsy and confusing. Hypothetical proposition which is also called Implicative, Alternative proposition and Disjunctive proposition in the modern sense are treated as Composite forms of Compound proposition by the Modern Logicians.

Taking p and q to stand for two simple propositions the different kinds of composite propositions may be expressed as follows :

Hypothetical
or — If p, then q.
Implicative

Alternative—Either p or q.

Disjunctive—Not both p and q.

A Hypothetical Proposition is one which can be expressed in the form 'If p, then q'; 'If A is B, then C is D'. 'If the boy can solve this problem, then he is intelligent'; 'If you are not a graduate, you will not get an appointment letter' are examples of Hypothetical propositions. It consists of two parts. The part, which contains the condition on which the assertion depends is called the antecedent

B. If the consequent does not depend on the antecedent, the proposition cannot be said to be a conditional proposition at all. So the view that all hypothetical propositions are always affirmative is generally accepted.

There is no difference of opinions with regard to the quantity of Hypothetical propositions. All hypothetical propositions which can be expressed in the form 'In all cases, if p, then q' are universal and all hypothetical propositions which can be expressed only in the form 'In some cases, if p, then q' are particular. Here p and q stand for propositions which may be affirmative or negative. 'If the animal is a lion, it is carnivorous' is a universal proposition, but 'If men are hard-working, they are successful' is a particular proposition.

An Alternative Proposition, is one which can be expressed in the form either p or q. Either A is B or C is D, 'Either Jadu or Madhu will be elected as chairman', 'The student is either intelligent or diligent,' 'Either he will go to Bombay or I shall go to Delhi' are examples of Alternative Propositions. There may be any number of alternants in an Alternative Proposition and they may be stated in any order.

An Alternative Proposition may be taken to be conditional, because no categorical assertion of a proposition is made here. There are several alternatives and the assertion of any of them depends on the denial of the others. Either A is B or C is D means that if A is not B, then C is D and if C is not D, then A is B.

There is difference of opinions between Mill and Ueberweg regarding the meaning of an Alternative Proposition. According to Mill *at least one* alternant of the Alternative Proposition is meant to be true, but according to Ueberweg *only one* alternant of the Alternative Proposition is meant to be true. So either p or q means, according to Ueberweg : If not p, q; If not q, p; If p, not q; and If q, not p, But it means, according to Mill, only the first two of these. Taking the minimum interpretation, Mill's view is accepted as correct. Of two alternants the denial of one leads to the affirmation of

A Disjunctive Proposition is one which can be expressed in the form 'Not both p and q'; Not both that A is B and C is D. It is not the case both that a man spends every pie he gets and also grows rich by leaps and bounds. It cannot be said that most Indians are poor, but still India is a highly prosperous country. You cannot both eat your cake and have it too. These are examples of Disjunctive propositions. There may be any number of disjuncts in a disjunctive proposition and they may be stated in any order.

A disjunctive proposition may be taken to be a conditional proposition in the sense that of two disjuncts the denial of one is dependent on the affirmation of the other. It should be noted, however, that though the affirmation of one disjunct implies the denial of the other, the denial of one implies nothing, since there is the possibility of the other disjunct being either true or false. One cannot be present both at Calcutta and at Delhi at the same moment, but one can be absent at both the places at the same moment. So denial of the presence of somebody at Calcutta implies neither his presence nor his absence at Delhi.

The Disjunctive Proposition primarily denies the possibility of something and so should be taken as negative in quality. Some logicians are of opinion that since the Disjunctive Proposition can be reduced to an equivalent hypothetical proposition and the hypothetical propositions are always affirmative, it should be taken as affirmative. This argument does not hold ground, because affirmation and negation are only the ways of expression. It is always possible to change an affirmative proposition into an equivalent negative proposition and *vice versa*, but still the distinction between the two forms of expression is admitted. So the view that the Disjunctive Propositions are always negative is acceptable.

The quantity of the Disjunctive Proposition depends on whether the statement is made in order to cover every case or some cases only. It is never the case that a man is present at Delhi and also that he is present at Calcutta at the same moment—is a univerthe other, but the affirmation of one does not lead to the denial of the other, since in some cases the possibility of affirming both alternants is not ruled out. He is either a fool or a rogue means he is at least one of these and may be both.

It may be noted that the difference between the opinions of Mill and Ueberweg is due to a confusion between the Alternative and Disjunctive proposition. The distinction between these two types of composite propositions was not recognised then. Mill, however, correctly interpreted the meaning of an Alternative proposition, though he named it as Disjunctive. On the other hand, Ueberweg, in his interpretation, included the meaning of both the Alternative and Disjunctive proposition and named it as Disjunctive

The Modern Logicians, by pointing out that Alternative and Disjunctive propositions are different kinds of proposition having different properties, have cleared this muddle. In the case of an Alternative proposition like Either p or q at least one of p and q is *true*; so the possibility of both being true is not ruled out. In the case of a Disjunctive proposition like Not both p and q, at least one of p and q is *false*, so the possibility of both being false is not ruled out. But if we assert both these propositions, 'Either p or q and not both p and q', *only one* of p and q is true and the other false. Here neither both can be true nor both can be false.

So, Either p or q = If not p, q; and If not q, p.
Not both p and q = If p, not q; and If q, not p.
Either p or q and not both p and q = If not p, q; If not q, p; If p, not q; and If q, not p.

There is no difference of opinions regarding the quality and quantity of alternative propositions. It is always affirmative since at least one alternant is affirmed in each case of an Alternative proposition. It is universal when it can be stated in the form : 'In all cases, either p or q'. It is particular when it can be stated only in the form :'In some cases, either p or q'. Triangles are either equilateral or isosceles or scalene is a universal proposition,but most Indians are either Hindus or Muslims is a particular proposition.

sal proposition. But most often it is not the case both that a man lives the life of a criminal and also that he goes unpunished—is a particular proposition.

It may be remarked that conditionality is not a proper distinguishing characteristic of the Hypothetical, Alternative and Disjunctive Propositions. The Traditional Logicians also sometimes used the term Conditional Proposition to mean only the Hypothetical Propositions. These three types of propositions are more properly called composite by the Modern Logicians. Besides the conjunction 'and', 'If . . . .then . . .,' 'Either. . . . or. . . .,' 'Not both. . . . and . . . . ' there are other logical conjunctions which combine simple propositions into single compound propositions. So these propositions are primarily compound.

These three forms of composite propositions are interrelated and the same fact can be expressed in each of these forms :

If there is the Sun, there is light—Hypothetical.
= If there is no light, there is no Sun—Hypothetical.
= Either there is no Sun or there is light—Alternative.
= Not both that there is the Sun and there is no light—Disjunctive.

These equivalences may be expressed symbolically thus :

If A is B, C is D—Hypothetical.
= If C is not D, A is not B—Hypothetical.
= Either A is not B or C is D—Alternative.
= Not both that A is B and C is not D—Disjunctive.

If p and q stand for proposition and $\overline{p}$ and $\overline{q}$ for their respective contradictories, the above equivalences can be expressed thus.

If p, then q—Hypothetical.
= If $\overline{q}$, then $\overline{p}$—Hypothetical.
= Either $\overline{p}$ or q—Alternative.
= Not both p and $\overline{q}$— Disjunctive.

(v) When a proposition asserts that there is a necessary relation between the Subject and the Predicate so that it cannot be otherwise, it is called a necessary proposition. A necessary proposition is capable of being expressed in the form A must be B or A cannot be B, e.g., Two and two must be four. Three angles of a triangle canno be less than two right angles. Brothers must be males.

When a proposition asserts that the relation between the Subject and the Predicate, though not necessary, is found to be so as a matter of fact, it is called an Assertory Proposition. It is expressed in the form 'A is B' or 'A is not B,' e.g., All crows are black; Some students are not intelligent; Palm trees are tall.

When a proposition asserts that the relation between the Subject and the Predicate is only probable, or not impossible, it is called a Problematic Proposition. It is expressed in the form A may be B or A may not be B, e.g., Some students may be found loitering on the Station Platform ; He is probably not getting a first class this time.

(vi) Traditional Logicians divided propositions from the standpoint of import into Verbal and Real.

A verbal proposition is one in which the Predicate merely states the connotation or a part of the connotation of the Subject, e.g., Men are animals; All men are rational animals.

A real proposition is one in which the Predicate states some facts not contained in the connotation of the Subject, e.g., Men are biped; Some men are intelligent.

Kant first used the terms 'Analytic proposition' and 'Synthetic proposition' in order to indicate propositions of the type Verbal and Real respectively. According to Kant, an analytic proposition is one in which the predicate repeats the subject in whole or in part. Thus all propositions which can be expressed in the form 'A is A' or 'AB is A' are analytic propositions. Synthetic propositions, on the other hand, are of the form 'A is B'. The predicate here expresses something different from the subject. 'Birds are birds', 'Gold ring is made of gold' are Analytic propositions. But 'Birds are biped' and 'Gold ring is costly' are synthetic propositions.

The Modern Logicians lay great stress on the distinction between Analytic and Synthetic propositions. They, however, consider the definition of Kant of these propositions too narrow, since he takes into consideration only subject-predicate types of propositions.

According to the Modern Logicians, a true Analytical Proposition is one whose negation is self-contradictory. Alternatively it is defined as a proposition whose truth can be determined solely by an analysis of the meaning of the words in the proposition itself. It is not necessary to investigate anything in the world apart from language to discover whether or not the proposition is true. Words, of course, are not used in the same sense always and in order to decide whether a proposition is analytic or synthetic, it is necessary to know exactly the meaning or the defining characteristics of the words used in the proposition under consideration. "The best student in the class is he who secures the highest mark" is analytic, if highest academic record be the defining characteristic of the best student. But if 'best student' means an all rounder in respect of study, conduct and extracurricular activities, it is a synthetic proposition.

Besides such doubtful cases, there are innumerable proposiions where it can be definitely stated whether the propositions are nalytic or synthetic. Brothers are males; If he is a Principal, he is he head of an educational institution; Either the water is hot or it s not hot; This is not both a chair and not a chair. All these ropositions are evidently analytic, because their negation is selfontradictory and no empirical verification is necessary to know hem to be true. Brothers are stronger than sisters; If he is a rincipal, he is rich; Either the water is hot or cold; This is not both chair and an object of decoration. These are synthetic proposions, because their negation does not involve self-contradiction. urther, in order to know whether the statements are true or not n appeal to experience is necessary.

If p, q, r, etc. stand for different simple propositions asserted as true and $\overline{p}$, $\overline{q}$, $\overline{r}$, etc, stand for the same simple propositions asserted as false, we may express all propositions using p, q, r, $\overline{p}$, $\overline{q}$, $\overline{r}$ etc. in order to note their form. Thus the form of the proposition— If he is a Principal, he is the head of an educational institution is If p, then q. Similarly the form of the proposition Either the water is hot or it is not hot is Either p or $\overline{p}$. A propositional form, which is always true whatever be the statements substituted for p, q etc., is called a tautology, p is p, If p, then p; Either p or $\overline{p}$. Not both p and $\overline{p}$ are tautologies, since whatever statements we substitute for 'p' the resulting propositions are bound to be true. On the other hand, p is q; If p, then q; Either p or q; Not both p and q are not tautologies. By substituting different statements for p and q, we may find that in some cases these propositional forms would yield Analytical propositions and in some cases Synthetical propositions. Thus for example, if p = He is a Principal and q = He is the head of an educational institution, then the proposition of the form 'If p, then q' is analytic, but if p = He is Principal and q = He is rich, then the proposition of the form 'If p, then q' is synthetic. It is clear from the above discussion that all tautological propositions are analytic but all analytical propositions are not tautologies.

Traditional propositional forms

Traditional Logicians supposed that a single sentence of any type can be reduced to a categorical proposition having a subject and a predicate and a copula. For the sake of clarity it is necessary to know whether this proposition is affirmative or negative and whether it is universal or particular. So in the case of every proposition, it is considered important to raise the question of quality and quantity of the proposition and thus to determine its logical form. Accordingly, four propositional forms have been traditionally recognised. They are symbolised as A, E, I and O.

A is the symbol for Universal Affirmative Proposition.

E is the symbol for Universal Negative Proposition.

I is the symbol for Particular Affirmative Proposition.

O is the symbol for Particular Negative Proposition.

If S stands for the subject and P stands for the predicate, the propositional forms are as follows :

A—All S is P—SaP.
E—No S is P—SeP.
I—Some S is P—SiP.
O—Some S is not P—SoP.

For the purpose of transforming ordinary sentences into logical propositions and determining their logical form, logicians have given several hints. They are useful, but it is advisable that the intention of the speaker and the meaning of the sentence be given due consideration while determining its logical form. Certain general forms of expressions, which usually indicate certain forms of logical propositions, are noted below :

1. An affirmative sentence whose subject is qualified by All or Any or Each or Every etc. or whose predicate is qualified by always or absolutely or necessarily etc., is reduced to an A proposition.

e.g., All men crave for happiness.
= All men are persons who crave for happiness.
= All S is P—A.
Each student had a pen.
= All students are persons who had pens.
= All S is P—A.
Religious men always believe in God.
= All religious men are persons who believe in God.
= All S is P—A.
Squares have necessarily equal angles.
= All squares are figures having equal angles.
= All S is P—A.

2. A negative sentence of the above type is reduced to an O proposition.

e.g., = All mangoes do not taste sweet.
= Some mangoes are not what taste sweet.

= Some S is not P—O.
Triangles are not necessarily equilateral.
= Some triangles are not equilateral.
= Some S is not P—O.

3. A sentence whose subject is qualified by Some or A few or Certain or Many or Almost all or Not a few etc, or whose predicate is qualified by mostly or frequently or nearly always or often or generally or sometimes or perhaps etc, is reduced to I or O propositions according as the sentence is affirmative or negative.

e.g., A few birds can utter certain words clearly.
= Some birds are animals that can utter certain words clearly.
= Some S is P—I.
Indian villagers mostly live in mud houses.
= Some Indian villagers are persons who live in mud houses.
= Some S is P—I.
Many children of our country do not get even Primary Education.
= Some children of our country are not those who get even Primary Education.
= Some S is not P—O.
Women generally do not appreciate honest criticism.
= Some women are not persons who appreciate honest criticism.
= Some S is not P—O.

4. A sentence whose subject is qualified by No or Not a singl etc. or whose predicate is qualified by never or not at all etc. i reduced to E.

e.g., No child should be allowed to play with a sharp blade.
= No child is one who should be allowed to play with a sharp blade.
= No S is P—E.

Really honest men never tell lies.
= No really honest men are persons who tell lies.
= No S is P—E.

5. A sentence whose subject is qualified by Few or Hardly any or Scarcely any or whose predicate is qualified by seldom, or rarely or infrequently, if *affirmative*, is reduced to O and if *negative* is reduced to I.

e.g., Scarcely any people act strictly in accordance with the dictates of their conscience.
= Some (most) people are not persons who act strictly in accordance with the dictates of their conscience.
= Some S is not P—O.
People seldom realise the difficulties of others.
= Some (most) people are not persons who realise the difficulties of others.
= Some S is not P—O.
Few men do not care for material prosperity.
= Some (most) men are persons who care for material prosperity.
= Some S is P—I.
Leaders rarely do not bother about public opinion.
= Some (most) leaders are persons who bother about public opinion.
= Some S is P—I.

We may note here some special kinds of propositions and their equivalences in A, E, I, O forms.

(i) Plurative Proposition

A proposition whose subject term is qualified by Most is called a plurative proposition. Propositions having Few, Scarcely any etc. as noted above, are also plurative. Most means more than half and from this meaning of 'most' we may draw inferences which cannot be done if it is substituted by 'some'. However in order to indicate whether such a proposition is A or E or I or O, we have no other alternative but to treat it as I or O. Thus Most S is P = Some S is P—I. Few S is P = Some S is not P—O.

(ii) Singular Proposition

A proposition whose subject indicates only one single object is called a singular proposition. It is universal or particular according as the individual is definite or indefinite. Such propositions cannot be put in the "All-No" form.

e.g., This dog is diseased—A.
This girl is not tall—E.
A (some) dog is barking in the street—I.
One (some) boy of your class is not promoted—O.

(iii) Exclusive Proposition

A proposition whose subject is qualified by Only or Alone or None but etc. is called an Exclusive proposition. From the meaning of such a proposition, it is reduced to either E or A or I proposition.

e.g., Only S is P.
= No non–S is P–E.
or
All P is S–A.
or
Some S is P–I.

None but the matriculates are admitted to this College.
= No non–matriculates are admitted to this College—E.
or
All persons admitted to this College are matriculates—A
or
Some matriculates are admitted to this College—I.

(iv) Exceptive Proposition

A proposition whose subject contains the word except or an of its equivalents is called an Exceptive proposition. From its meaning it is treated as either universal or particular according as th exception is definite or indefinite.

e.g., All teachers except the trained ones are liable to be discharged.

= All untrained teachers are liable to be discharged—A.

All teachers except one are liable to be discharged.

= Some teachers are liable to be discharged—I.

In order to express the meaning of such propositions more clearly,they are reduced to two propositions. The first proposition can be reduced thus :

No trained teachers are liable to be discharged –E.

& All other teachers are liable to be discharged—A.

The second proposition can be reduced thus :

Some (one) teacher is not liable to be discharged—O.

& Some (all other) teachers are liable to be discharged—I.

(v) Infinite Proposition and Proposition with negative Predicate

A proposition whose predicate is an infinite term is called an Infinite proposition. If the predicate is a negative term, it is treated by the Traditional Logicians as affirmative if the form of the proposition itself is not negative.

e.g., Mind is non-solid—A.

All roses are not-black—A.

No dress in this shop are non-coloured—E.

Some tables are non-circular—I.

Some people of this locality are not non-Oriyas—O.

(vi) Indesignate Proposition

A Proposition whose subject does not indicate any quantity is called an Indesignate or Indefinite proposition. It is distinguished from the Predesignate proposition where the quantity is definitely indicated. In predesignate proposition, it is easy to determine the quantity of the proposition, but in indesignate proposition, the quantity is determined by taking into consideration the meaning of the proposition and the intention of the speaker. The following are examples of both indesignate and predesignate propositions.

e.g., Men are always selfish = All men are selfish—A.
Some men are always selfish—It is in logical order—I.
Men are stronger than women = Most men are stronger than women = Some men are stronger than women—I.
Swans are sometimes black = Some swans are black—I.
All men sometimes commit mistakes in life.
= All men are persons who sometimes commit mistakes in life–A.
Men are not machines.
= No man is a machine—E.

(vii) Impersonal Proposition

A proposition where predication is made of something lef vague is called an Impersonal proposition. It generally begins wit an indefinite 'it'. The circumstance under which it is stated determines the subject. While reducing to a proper logical propositio it is necessary to state the subject definitely.

e.g., It is raining = The weather is rainy—A.
It is very cold to-day = The weather is very cold to-day—A

It should be noted that the indefinite 'it' differs from th introductory 'it' which merely anticipates what follows.

e.g., It is good to get up early = To get up early is good—A.
It is not decent to smoke in front of elders.
= To smoke in front of elders is not decent—E.

(viii) Relational Proposition

A relational proposition is one which states a relation betwee two or more terms. The Himalayas is to the North of India. Her the terms are 'The Himalayas' and 'India' and the relation is 'nort of'. Ram gave a book to Hari. Here the terms are 'Ram', 'a boo and 'Hari' and the relation is 'giving'.

The Traditional Logicians would treat such propositions subject-predicate propositions. The first proposition according them is—(The Himalayas) is (to the North of India)—A. Th subject and predicate have been shown in brackets. The secon proposition, similarly, is—(Ram) is (a person who gave a book to Hari)—A.

According to the Modern Logicians such propositions are fundamentally different from the subject-predicate propositions and should be analysed into the relation and the terms involved. The first proposition is in the form R (x,y) or xRy, where R stands for the relation and x, y for the terms. Similarly the second proposition is in the form R (x, y, z).

(ix) Hypothetical, Alternative and Disjunctive Proposition

The Traditional Logicians would treat these propositions as conditional, but they have their categorical equivalents, e.g.,

If A is B, C is D = All or some cases of A's being B are cases of C's being D—A or I.

The other conditional propositions also can be similarly shown.

The Modern Logicians treat them as composite propositions.

(x) Interrogative, Imperative, Optative and Exclamatory Sentences

The Modern Logicians recognise some interrogative sentences as genuine propositions since an assertion is implied there.

e.g., Who is not imperfect ? = All men are imperfect—A.
Who is absolutely honest ? = No man is absolutely honest—E.

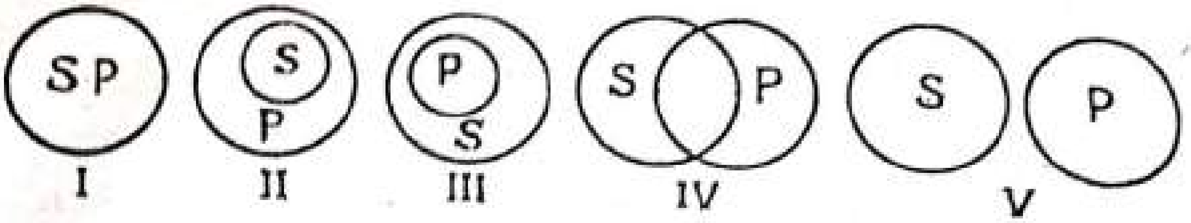
All other forms of such sentences where there is no assertion are not taken as propositions by the Modern Logicians.

The Traditional Logicians would, however, reduce such sentences into propositions by taking the subject as "My question to you" or "My command to you" or "My wish" etc.

e.g. What is your name ? = (My question to you) is (as to what your name is)—A.
Come in = (My command to you) is (to come in)—A.
May God bless you = (My wish) is (that God may bless you)
What a grand view ! = (The view) is (grand)—A.

Diagrammatic Representation of Propositons

The A, E, I and O propositions are considered by the Traditional Logicians as expressions of the relation of inclusion or exclusion between two classes indicated by the Subject and the Predicate. Euler represented these class relations diagrammatically, by taking circles to represent the denotation of the Subject and the Predicate. The diagrams known as Euler's Circles are as follows :



These are all the diagrams by which two circles can possibly be wholly or partially included or excluded. So they represent all possible statements regarding the relation of the denotations of two terms which may be used as the subject and the predicate of propositions.

It is important to notice that there are four propositional forms but five diagrams. So there is no simple one to one correspondence between the diagrams and the propositional forms.

When the relation between any two terms, S and P, is as in diagram I, we can assert four statements involving S and P, *viz.*, All S is P, All P is S, Some S is P and Some P is S.

When the relation between any two terms, S and P, is as in diagram II, we can assert four statements again, *viz.*, All S is P, Some P is S, Some S is P and Some P is not S.

Similarly diagram III allows the assertion of four statements, *viz.*, Some S is P, All P is S, Some S is not P and Some P is S; diagram IV allows the assertion of four statements, *viz*, Some S is P, Some P is S, Some S is not P and Some P is not S; and diagrams V allows the assertion of four statements,*viz*, No S is P, No P is S, Some S is not P and Some P is not S.

So if we know, with regard to two classes that they are related exactly in the way as the circles in any one diagram, then we know more than what can be stated by one of the A, E, I, O propositions.

It may be noticed from the above that propositions of the A form may be represented by diagrams I and II, but not by the diagrams III, IV and V. Similarly, E may be represented by diagram V, but not by the others; Proposition I may be represented by diagrams I, II, III and IV, but not by V and O may be by represented by diagrams III, IV and V, but not by I and II.

Any statement, which does not exclude at least one diagram, gives no information at all. Thus if we say that a class X is wholly or partially included in or excluded from another class Y, then we cannot express the relation between X and Y in any of the A, E, I, O forms. We have said that the relation between X and Y is either All X is Y or No X is Y or some X is Y or Some X is not Y, but this asserts nothing of the relation between X and Y.

Distribution of Terms

A term in any proposition is said to be *distributed* when it is taken in its entire denotation, i.e .,when reference is made to every member of the class for which the term stands.

A term in any proposition is said to be *undistributed* when a part of its denotation is taken into consideration, i.e., when reference is made to some members of the class for which the term stands.

In Universal propositions, the subject term is distributed since here the subject is clearly taken in its entire denotation and the predicate is affirmed or denied of every member of the denotation of the subject. All men are mortal means that all members of the class man, i.e., Ram, Hari, Govind, Gopal etc. are also members of the class mortal beings. Similarly, No man is perfect means that every member of the class man, i.e., Ram, Hari, Govind, Gopal etc. is not a member of the class perfect being. So A and E propositions distribute their subjects.

In Particular propositions, the subject term is undistributed, since here a part of the denotation is taken into consideration. The predicate is affirmed or denied of some members of the denotation of the subject. Some men are intelligent means that some individuals of the class man are included in the class intelligent being. Nothing is said here about the other members of the class. Similarly, Some men are not religious means some individuals of the class man are not members of the class religious being. Here again nothing is said about the other members of the class. So I and O propositions do not distribute their subjects.

In affirmative propositions, all or some of the individuals of the subject class are said to be members of another class indicated by the predicate term. No indication is there to know whether they are all the members of the predicate class or they only form a section of that class. In either case, however, we are sure that some members are involved leaving the case of all uncertain. The predicate is, therefore, taken as undistributed. So A and I propositions do not distribute their predicate.

In negative propositions, all or some of the individuals of the subject class are said to be not members of the class indicated by the predicate term. These individuals are excluded from the entire denotation of the predicate. The predicate is, therefore, distributed. So E and O propositions distribute their predicate.

We may state the result of the above discussion thus :

In A proposition, the subject is distributed and the predicate is undistributed.

In E proposition both the subject and the predicate are distributed.

In I proposition no term is distributed.

In O proposition the subject is undistributed but the predicate is distributed.

Two rules of distribution summarise this result :

1. Universal propositions distribute their subjects.
2. Negative propositions distribute their predicates.

The distribution of terms in the A, E, I, O propositions can also be known by making a reference to the diagrams of Euler.

All A propositions of the form All S is P can be represented by the first two diagrams. In both the cases S is taken in its entire extent, but P, though taken in its entire extent in the first diagram, is not so taken in the second diagram. Only a part of P is occupied by the circle S. So generally speaking, we may say that in A proposition, the subject S is distributed, but the predicate P is not distributed.

All E propositions of the form No S is P can be represented by the last diagram. Here we find that the whole of S is outside the whole of P. So in E proposition, both the subject S and the predicate P are distributed.

All I propositions of the form Some S is P can be represented by the first four diagrams. In the first two diagrams any part of S occupies a part of P. In the third diagram a particular part of S may be the whole of P or a part of P. In the fourth diagram only a particular part of S occupies a particular part of P. So generally speaking, we may say that in I proposition, S is not distributed and P is also not distributed.

All O propositions of the form Some S is not P can be repre;ented by the last three diagrams. In the last diagram any part of S s outside the whole of P. In the third and fourth diagrams a)articular part of S is outside the whole of P. The 'Some S' of the)roposition Some S is not P is always outside the whole of P. So in) proposition, S is not distributed but P is always distributed.

It may be noticed that diagrams three and four illustrate both and O propositions. So different parts of S must be taken for the ffirmative and the negative propositions.

Existential Import of Propositions

Statements may have a sense or meaning; or they may be non-sensical or meaningless. In English language, Cows eat grass; Delhi is not in India, The angle is either 30° or 80° are statements having sense. But Prits dijmun, Either and sleep Cow, 30° eats grass are non-sensical statements.

Statements having sense may be true or false. 'Cows eat grass' is a true statement and 'Delhi is not in India' is a false statement.

Again a statement may imply the existence of the things about which it states, or may not imply existence, though in either case it may have a sense. 'If any student of the College creates trouble in the meeting, he will be punished' does not imply that the speaker asserts that there are some students of the College who will create trouble in the meeting and that they will be punished. But 'Some students of the College are trouble-mongers' implies that the speaker asserts that there are some students of the College who are trouble-mongers.

The above three criteria are obviously different from each other.

In order to determine the existential import of a proposition, we raise the question—Does the proposition import or imply the existence of the objects about which it is the statement, or it does not imply such existence ?

Some people believe in some sort of an existence of objects like ghost, demon, flying horses etc., and may give statements about them, while others may not believe in the existence of such objects. But here we are not concerned with who believes in what, or which propositions are true and which false. In determining the existential import of a proposition, we analyse the significance of the proposition itself and find out whether it does imply the existence of individuals indicated by the terms or it does not imply either their existence or their non-existence.

The Modern Logicians point out that A and E propositions are existentially negative whereas I and O propositions are existentially affirmative.

Let us consider the proposition—All students of the College having less than 60 % of attendance will be detained. This proposition does not imply that the speaker already knows that there are some students in the College who have less than 60 % of attendance. As a matter of fact, there may be or may not be such students in the College. It is immaterial whether there be such students or not, but still the authorities may announce this. This statement may be given in the prospectus of the College or notified in the beginning of the session with the intention of keeping the class of such students empty. So such a proposition is equivalent to "If there be students having less than 60% of attendance, they will be detained." This only means that there will be no student, who has less than 60% of attendance and not detained. So such a proposition is said to be existentially negative.

Of course, there may be cases where an A proposition is asserted with a prior knowledge of the existence of the denotation of the subject term. A doctor may examine each and every student of a college and may come to the conclusion that all the students of the college had primary vaccination. But the propositional form All S is P cannot, therefore, be interpreted that it implies the existence of S. In every case, however, it does mean that the class 'S and not-P' is empty. The doctor's proposition can also be interpreted as not-primarily-vaccinated-college students=0. So we may express the significance of All S is P as $S\,\overline{P} = 0$, where $\overline{P}$ stands for not-P.

It follows from the above consideration that an E proposition, e.g., 'No students of the college having less than 60 % of attendance will be promoted' is also existentially negative. It does not depend, for its assertion, on there being such students in the college. It only means that there are not students having less than 60 % of attendance and getting promotion. So No S is P can be expressed as $SP=0$.

Now let us consider the significance of I and O propositions. 'Some students of the College who have secured poor marks will be detained.' Here it is presumed that there is at least one student or a number of students of the College who have secured poor marks and the proposition asserts that they will be detained, 'Some students of the College who will secure poor marks will be detained.' Here it is not irrelevant to ask how do you know that they will secure poor marks and the speaker is not expected to say that he does not assert that they will secure poor marks; he rather gives reason why he thinks that they will. These propositions may turn out to be either true or false, but the propositions signify that the speaker is taking for granted that there are such students in the College. So these propositions are said to be existentially affirmative. So Some S is P may be expressed as $SP \neq 0$, which means that the conjoint assertion of S and P is not an empty class. Similarly, 'Some students of the College who have secured poor marks will not be promoted' signifies that there are some students who have secured poor marks and they will not be promoted. So Some S is not P can be expressed as $S\bar{P} \neq 0$.

From the above discussion we conclude that the minimum interpretation of universal propositions does not require that the class indicated by the subject term must have some members but that of particular propositions does require this.

The A, E, I, O propositions, therefore, can be formulated thus :

A—All S is P—Nothing is both S and not-P—$S\bar{P} = 0$
E—No S is P—Nothing is both S and P—$SP=0$
I—Some S is P—Something is both S and P— $SP \neq 0$
O—Some S is not P—Something is both S and
not-P— $S\bar{P} \neq 0$.

This interpretation of the significance of the A, E, I and O propositions has led the Modern Logicians to hold the view that the difference between the affirmative and the negative propositions is not fundamental, whereas the difference between the universal and the particular propositions is fundamental. The universal propositions do not logically imply existence of members in the class indicated by the subject term; but particular propositions do logically imply existence of members in the class indicated by the subject term. Further it follows from this that logically we cannot infer a particular proposition having 'Some S' as subject from one or more universal propositions, unless we make the additional assumption in the premises that S has members. It may be noted that this assumption is implicit in the discussion made by the traditional logicians on syllogism and other inferences, otherwise some of their accepted valid reasonings shall have to be considered invalid.

Sevenfold Relation of Propositions

Every proposition is either true or false. The truth or falsity of propositions is determined by facts. But in some cases the truth or falsity of one or more propositions may determine the truth or falsity of another proposition and we have no need to refer to facts. This way of determining the truth-value of a proposition is logical and it is different from the empirical determination of the truth-value of the proposition which makes a reference to facts. It is of fundamental importance, therefore, that we know how propositions are related to each other.

Examination shows that there are seven kinds of relation between propositions. Any two propositions must be related in one of these seven different ways. The seven relations between propositions are : (i) Independence, (ii) Equivalence or Co-implication, (iii) Super-implication or Superalternation, (iv) Sub-implication or Subalternation, (v) Contrariety, (vi) Sub-contrariety and (vii) Contradiction.

Taking p as the symbol of one proposition and q as the symbol of another proposition, we may explain these relations as follows :

(i) *Independence*—p and q are said to be independent of each other, when the truth or falsity of one is incapable of determining the truth or falsity of the other. Propositions having unrelated subjects and unrelated predicates are obviously independent, e.g., This pen is costly and all roses are red are independent of each other.

(ii) *Equivalence or Co-implication*— p and q are said to be equivalent or co-implicant of each other, when the truth of one implies the truth of the other and the falsity of one implies the falsity of the other. So if p is true, q is also true and if p is false, q is also false. Similarly, if q is true, p is also true and if q is false, p is also false. So they are identical in meaning, e.g., 'Ram killed Ravana' and 'Ravana was killed by Ram' are equivalent or co-implicant propositions. In fact, it is the same proposition expressed differently.

(iii) *Superimplication or Superalternation*—p is said to be superimplicant or superalternant of q, when if p is true, q is true, but if p is false, q is undetermined. If 'All the students of this College are Hindus, be a true proposition, 'Some students of this College are Hindus', is also true. But if 'All the students of this College are Hindus' be a false proposition, we cannot say whether some of them are Hindus or not. None of them might have been Hindu as well. So 'All the students of this College are Hindus' is superimplicant or superalternant of 'Some students of this College are Hindus.'

(iv) *Subimplication or Subalternation*— p is subimplicant of q, when if p is false, q is also false, but if p is true, q is undetermined. If 'Some students of this College are Hindus' is a false proposition, then 'All students of this College are Hindus' is obviously false; but if 'Some students of this College are Hindus' is true, we cannot say whether 'All the students of the College are Hindus' or not; some of them might be of some other religions as well. So 'Some students of this College are Hindus' is subimplicant or subalternant of 'All students of this College are Hindus.'

It may be noticed that if a proposition R is superimplicant to S, then S is subimplicant to R.

(v) *Contrariety*— p and q are said to be contrary of each other, when if p is true, q is false and if q is true, p is false; but if p is false, q is undetermined and if q is false, p is undetermined. So the truth of anyone of them implies the falsity of the other, but the falsity of anyone of them cannot determine the truth-value of the other. If

'All the students of this College are Hindus' is true, then 'No students of this College are Hindus' is false;and if 'No students of this College are Hindus' is true, then 'All students of this College are Hindus' is false. But if 'All students of this College are Hindus' is false, we cannot say whether 'No students of this College are Hindus' is true or not, since some of them or none of them might have been Hindus. Similarly, if 'No students of this College are Hindus' is false, we cannot say whether 'All students of this College are Hindus' is true or not, since only some or all might have been Hindus. So 'All students of this College are Hindus' and 'No students of this College are Hindus' are contrarily related.

It may be noticed that of two contrary propositions both may be false, but both cannot be true. 'All men are blind' and 'No men are blind— both are false, but both of them cannot be true.

(vi) *Subcontrariety*— p and q are said to be subcontrary of each other,when if p is false, q is true and if q is false, p is true; but if p is true, q is undetermined and if q is true, p is undetermined. So the falsity of anyone of them implies the truth of the other; but the truth of anyone of them cannot determine the truth-value of the other. If 'Some students of this College are Hindus' be false, then 'Some students of this College are not Hindus' is true; and if 'Some students of this College are not Hindus' is false, then 'Some students of this College are Hindus is true. But if 'Some students of this College are not Hindus be true, we cannot say whether 'Some students of this College are not Hindus' is true or false, because the remaining students might or might not have been Hindus . Similarly if 'Some students of this College are not Hindus' be true, we cannot say whether 'Some students of this College are Hindus' is true or false. So 'Some students of this College are Hindus' and 'Some students of this College are not Hindus' are subcontrarily related.

It may be noticed that of two subcontrary propositions both may be true, but both cannot be false. 'Some men are blind' and 'Some men are not blind'—both are true, but both of them cannot be false.

(viii) *Contradiction*— p and q are said to be contradictory of each other,when if p is true, q is false and if q is true, p is false; again if p is false, q is true and if q is false, p is true. So the truth of anyone of them implies the falsity of the other and the falsity of anyone of them implies the truth of the other. If 'All students of this College are Hindus' is true, then 'Some students of this College are not Hindus' is false. If 'Some students of this college are not Hindus' is true, then 'All students of this College are Hindus' is false. Again if 'All students of this College are Hindus' is false, then 'Some students of this College are not Hindus' is true; and if 'Some students of this College are not Hindus' is false, then 'All students of this College are Hindus' is true. So 'All students of this College are Hindus' and 'Some students of this College are not Hindus' are contradictorily related. Similarly, 'No students of this College are Hindus' and 'Some students of this College are Hindus' are contradictories.

Opposition of Propositions

The Traditional Logicians confined their study of the relation of propositions to the propositions of the A-E-I-O scheme. Since propositions having different subjects and different predicates are likely to be unrelated to each other, only the relations of propositions having the same subject and the same predicate are examined. Thus viewed only four kinds of relation between the A, E, I and O propositions are possible and they are all relations of some sort of opposition. Opposition of propositions is, therefore, defined as the relation between two propositions having the same subject and the same predicate differing either only in quality or only in quantity or in both. The four kinds of opposition of propositions are—

(i) Subaltern opposition or Subalternation,

(ii) Contrary opposition,

(iii) Subcontrary opposition and

(iv) Contradictory opposition.

(i) *Subaltern opposition*— It exists between two propositions having the same subject and the same predicate differing only in quantity. A and I as well as E and O are related thus. Here the truth of the universal implies the truth of the particular; the falsity of the particular implies the falsity of the universal; but the falsity of the universal and the truth of the particular do not imply any truth-value of the corresponding propositions.

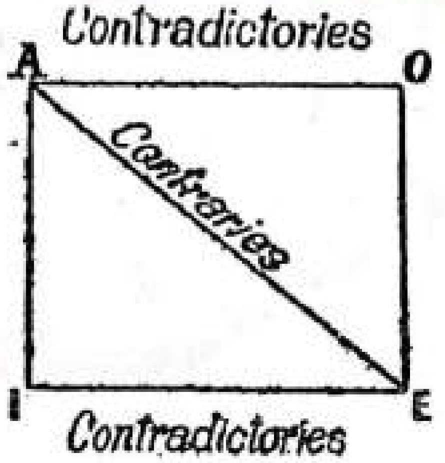
(ii) *Contrary opposition*—It exists between two *universal* propositions having the same subject and the same predicate. So they differ only in quality. A and E are related thus. Here the truth of one implies the falsity of the other; but the falsity of one does not imply any truth-value of the other.

(iii) *Subcontrary opposition*—It exists between two particular propositions having the same subject and the same predicate. So they differ only in quality. I and O are related thus. Here the falsity of one implies the truth of the other; but the truth of one does not imply the truth-value of the other.

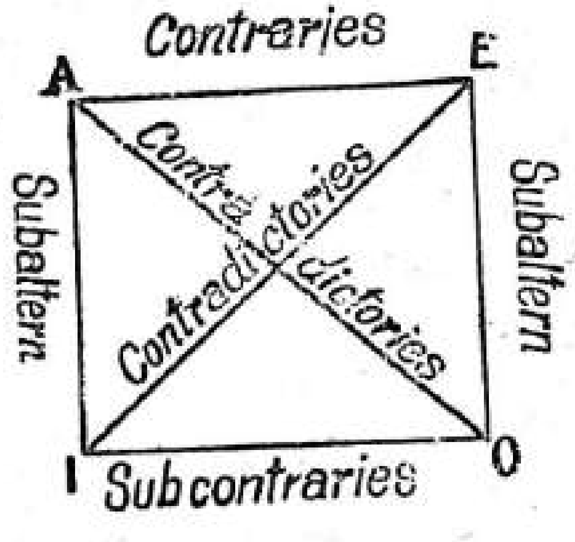
(iv) *Contradictory opposition*—It exists between two propositions having the same subject and the same predicate differing both in quality and quantity. A and O as well as E and I are related thus. Here the truth of one implies the falsity of the other, and the falsity of one implies the truth of the other.

It should be noted that in the discussion of oppositions of propositions, the Traditional Logicians had assumed that none of the classes indicated by the terms is empty.

Aristotle did not recognise subalternation and subcontrary relations as opposition, since two propositions related in these ways may be simultaneously true. He represented the oppositions of propositions by a square using the longest line, i.e., the diagonal to epresent the opposition between two Universal Propositions. Aristotle's square of opposition is drawn thus :

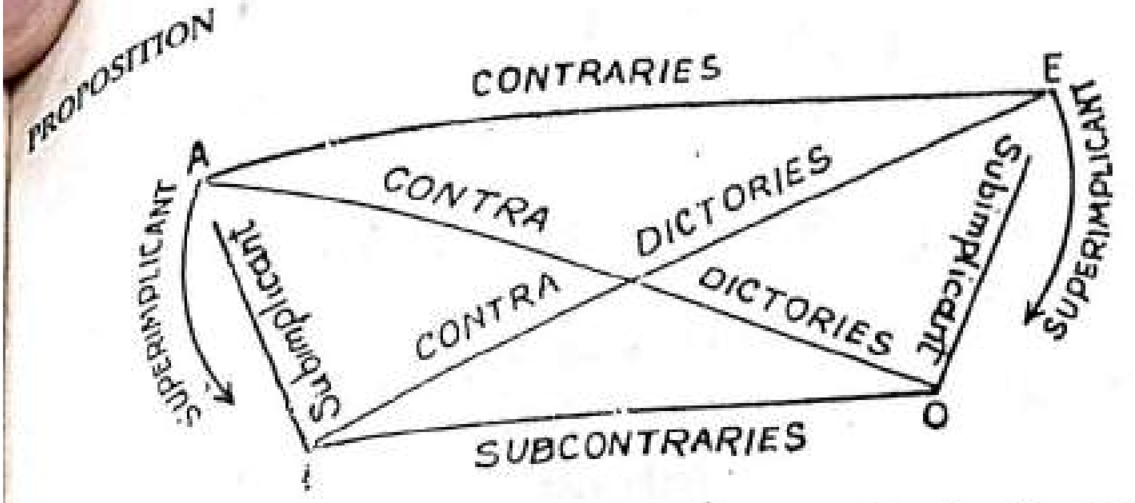


Other Traditional Logicians use the term 'Opposition of propositions' in a technical sense such that it covers all the possible relations between the propositions of the A-E-I-O scheme. It is pointed out that the subalterns also differ in quality and two propositions like I—some men are blind and A—All men are blind, are not simultaneously true. Two subcontraries differ in quality and when I proposition like 'Some men are mortal' is false, the corresponding O proposition 'Some men are not mortal' is true. So they draw the square of opposition thus :



This is generally named as the Common Square of oppositions. Here contradictory opposition, which is the perfect form of opposition, is represented by the longest lines, while the other imperfect forms of opposition are represented by the sides of the square.

The Modern Logicians remark that the perfect symmetry of the square cannot properly represent the oppositions of the propositions. So they draw the figure of oppositions thus :



Headmaster,
Bediabalanga High School
Sorisakotha

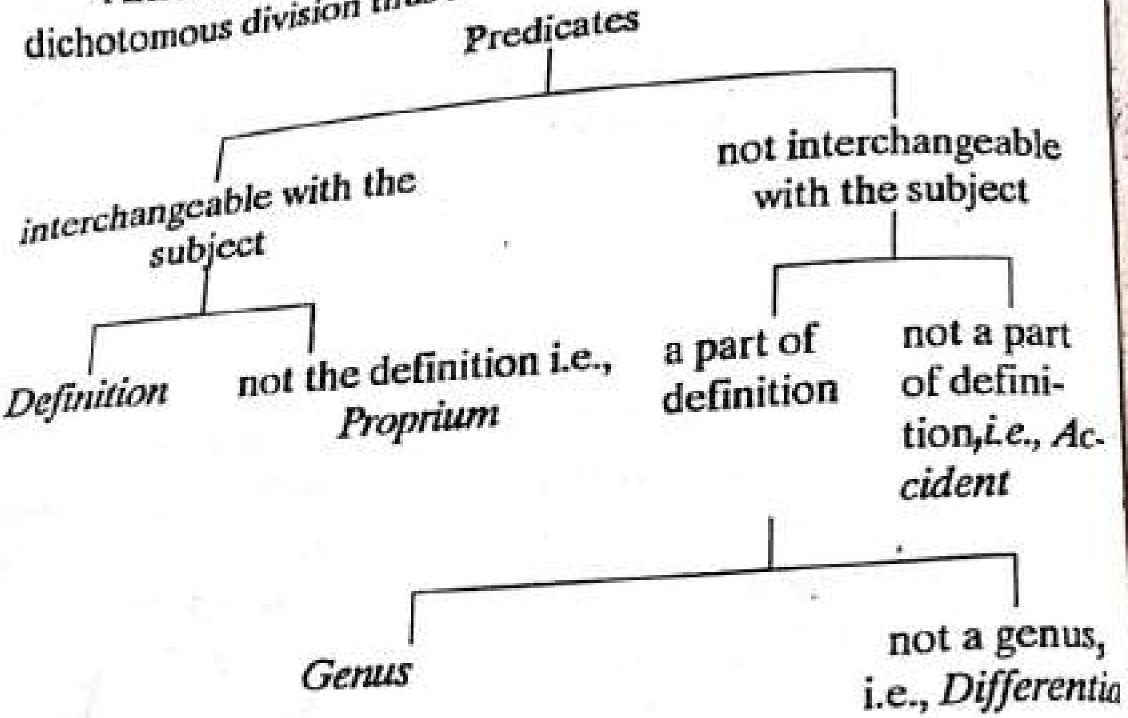
One speciality of this figure is that superimplication and subimplication relations are indicated separately.

Predicables

Predicable is the name of the relation in which the predicate of a proposition stands to the subject. Aristotle raised the question of the Predicables in order to know how many different *kinds* of predicate can be affirmed of a class of things so that its definition can be determined. According to Aristotle all the characteristics that can be predicated of a class may be of four kinds. The predicate may be either the genus or differentia or property or accident of the subject. Thus for example, if we take the term 'man' as the subject, we may predicate of it characteristics like being an animal or being a mammal etc., and these are genera of man. We may also predicate of it the characteristic—rationality, which is the differentia of man. Similarly, we can predicate of man characteristics like being capable of seeing a joke or being capable of learning grammar etc., and these are propria of man. Again characteristics like being biped or having hair etc, which can be predicated of man, are its accidents. So according to Aristotle the predicables or the terms which can be predicated of a class of things are of four kinds, viz., genus, differentia, proprium or property and accidens or accident of the subject. The genus and the differentia taken together constitute the definition of the subject term and may be considered as a fifth kind of predicable.

It is clear from the above discussion that according to Aristotle, the predicate cannot be a species of the subject term. This is so, because he concerned himself in examining the possible predicates of an entire class of things and in an A-proposition the predicate cannot be a subclass of the subject term.

Aristotle's list of predicables can be shown in the form of a dichotomous division thus :


Predicates
interchangeable with the subject
not interchangeable with the subject
Definition
not the definition i.e., Proprium
a part of definition
not a part of definition, i.e., Accident
Genus
not a genus, i.e., Differentia

Aristotle discussed about the predicables in order to distinguish the essential characteristics or the connotation of a term from its inessential characteristics. He believed that every natural species like Cow, Horse or Crow had a fixed connotation which must be set forth in the definition. So any subject term, of which the predicate is the definition, is interchangeable with the predicate, e.g., Men are rational animals and Rational animals are men. The proprium, though not a part of the essence of the species, is nevertheless essential, since it follows from the essence and so it is also interchangeable with the subject, e.g., 'Men are capable of learning grammar' and 'Those capable of learning grammar are men'. Parts of definition, i.e., genus and differentia taken separately are naturally not interchangeable with the subject. So also accidental characteristics are not interchangeable with the subject, e.g., 'Men are bipeds', but we cannot say that 'Bipeds are men'.

The Modern Logicians while appreciating the clear analysis of Aristotle do not support the view that every term has a fixed connotation or a fixed definition.

Porphyry discussed about the Predicable from the standpoint as to what may be the predicates of any possible subject, i.e., an entire class, a part of the class or an individual. He recognised five kinds of predicables. They are genus, species, differentia, property and accident. We may illustrate them by taking 'triangle' as the subject term.

Genus—Triangles are rectilinear closed figures.

Species — Some triangles are equilateral.

Differentia —Triangles are bounded by three straight lines.

Property —Triangles are those the sum of whose angles is equal to two right angles.

Accident— Some triangles are drawn on the blackboard.

It may be noted that while discussing on predicables Aristotle considered only the A propositions, but Porphyry considered both A and I propositions. Species was not recognised as a predicable by Aristotle, but Porphyry recognises it to be a predicable. Logicians differ with regard to the sort of propositions which illustrate the predicable species. According to some, a proposition like 'Ram is a man' illustrates this predicable, since man is the natural species to which Ram belongs. This is obviously a confusion between the term species in the biological sciences and the term species in logic. Man, no doubt, is a biological species, but it cannot be considered to be a species in the logical sense of the term Ram, since Ram does not indicate a class of which man is a sub-class. Species in the logical sense is always a subclass of a higher class of which it is the species. So the predicable here is rather Accident, since Ram's being a man is accidental. The name could have been given to a horse or a dog or anything else.

According to some logicians, the predicable of a proposition like 'Some animals are men' is species, since man is a logical species of the class 'animal'. But here also some critics raise an objection. According to them, this proposition means that a section of the class 'animal' is recognised or defined as man. So here the predicable is definition.*.

EXERCISE

1. What is proposition ? How does it differ from a judgement ? How does it differ from a sentence ?
2. Give the traditional analysis of a logical proposition. What is the nature of logical copula ?
3. Write notes on the following :
    - (a) Simple proposition
    - (b) Composite proposition
    - (c) Relational proposition
    - (d) Exponible proposition
    - (e) Indesignate proposition
    - (f) Impersonal proposition.
4. What is meant by Distribution of terms ? Explain Eular's diagrams and determine the distributed terms in A, E, I and O propositions.
5. What do you mean by Existential import of proposition ? Show why the quantitative difference of propositions is considered more fundamental than their qualitative difference.
6. What are the seven relations of propositions ? Explain and illustrate them.
7. What is the Opposition of propositions ? Is Subalternation an opposition ?
8. Explain and illustrate the different kinds of predicables. Is Species a predicable ?
9. How do you determine the quantity of Singular propositions and the quality of Hypothetical propositions ?

0. Reduce the following to A, E, I, O form and indicate the terms distributed.
    - (a) Bears never eat dead bodies.
    - (b) Every Sunday is a holiday.
    - (c) Most villagers are simple.
    - (d) All politicians are not dishonest.
    - (e) The Mahanadi is the longest river in Orissa.
    - (f) Brave persons seldom fear.
    - (g) Man is never happy.
    - (h) Only the Hindus are worshippers of Lord Siva.

(i) Every learned man is not cultured.
(j) He is neither a Hindu nor a Muslim.
(k) A cow has two horns.
(l) A cow has entered the garden.
(m) Mahatma Gandhi took the leadership of Indian Independence Movement.
(n) May God bless you.
(o) Who does not wish the welfare of his children ?
(p) Please read the paragraph carefully.
(q) Oh ! how painful !
(r) Honesty is the best policy.
(s) If he speaks the truth, he will not be punished.
(t) It is very cold to-day.
(u) The boy is either a fool or a rogue.
(v) Some inmates of this Hostel are non-Indians.
(w) Every man sometimes in life has philosophical thoughts.
(x) You cannot both be pious and torture animals.
(y) It is good to have morning exercise.
(z) Students should not waste their time by reading only story books.

11. Determine the predicables in the following propositions :

(a) Crow is a bird.
(b) Some unsocial persons are the leaders of this movement.
(c) Triangle is three-sided.
(d) Ram is a brave boy.
(e) The Sun is self luminous.
(f) Some beasts are domestic.
(g) Equilateral triangles are equiangular.
(h) This saint is meditating.
(i) This girl is born on the new moon day.
(j) Snakes are poisonous.
(k) Dead bodies are unconscious.
(l) Some Schools of this town are Lower Primary.

12. State the propositional forms of the different kinds of composite propositions and determine the equivalent composite propositions of the following :

(a) If M is N, S is T.

(b) Either he is intelligent or he is diligent.

(c) Not both that you have intemperate habits and also that you are healthy.

(d) All crows are black.

Rules of Conversion

1. The subject of the Convertend becomes the predicate of the Converse and the predicate of the Convertend becomes the subject of the Converse.

2. The quality of the Convertend is retained in the Converse.

3. The term which is not distributed in the Convertend is not distributed in the Converse.

The first rule is involved in the very definition of Conversion. The second rule is concerned with the quality of the convertend and the converse. Since the terms remain the same, their inter-changing of places does not necessitate any qualitative change. The third rule is a general principle of all deductive inference. In any conclusive inference we cannot go beyond the evidence, cannot assert anything not implied in the original proposition. So a term which is not distributed in the convertend cannot be distributed in the converse.

Application of these rules leads to the following schema of Conversion.

Convertend		Converse
A—All S is P.	→	Some P is S—I.
E—No S is P.	=	No P is S—E.
I—Some S is P.	=	Some P is S—I.
O—Some S is not P.		None.

The symbol '→' shows that the converse is not equivalent. So by converting the converse we do not get the original proposition. The symbol '=' means equivalent. So by converting the converse we get the original proposition.

The converse of A is I. It could not be A, because in that case 'P' which was not distributed in the A premise would have been distributed in the conclusion. The converse of A is not its equivalent but its subimplicant. This form of conversion is called *conversion by limitation or conversion per accidens.* The converse of A—All men are animals cannot be A—All animals are men, but must be I—Some animals are men.

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The converses of E and I propositions are their respective equivalents. Thus the convertend E—No men are beasts, and its converse E—No beasts are men, are equivalent propositions. Similarly, the convertend I—Some men are blind animals, and its converse I—Some blind animals are men are also equivalents. Such a form of conversion is called *Simple conversion.*

O proposition cannot be converted. In accordance with the first two rules, the converse of O—Some S is not P should be a negative proposition with S as its predicate. But here the third rule will be violated, since S would be distributed in the converse without being distributed in the convertend.

Some logicians convert O proposition by a process called *Conversion by Negation* thus :

Convertend —O—Some S is not P.
= I—Some S is not-P.
Converse — I—Some not-P is S.

Here the original O proposition is changed into an I proposition by transferring the negative particle to the predicate. Then the I proposition is converted to I.

This process, however, cannot be accepted as conversion, because the first two rules of conversion have been violated here. The subject of the conclusion here is not the predicate of the premise but its contradictory, and the quality of the conclusion is affirmative, though the premise is negative. Further, it will be seen that the conclusion here is same as the conclusion of the partial contraposition of the O proposition.

Generally, A proposition is converted by limitation, but in some cases of A propositions, it is possible to convert them simply. Such A propositions are called by Hamilton as U propositions in order to distinguish them from the ordinary A proposition where the predicate is not distributed. Such a proposition can be diagrammatically represented by the diagram I of Eular. Since both the subject and predicate of such propositions are of equal denotation, they are both distributed.

e.g., Convertend —A—All men are human beings.
Converse —A—All human beings are men.
Convertend —A—All men are rational animals.
Converse —A—All rational animals are men.
Convertend —A—The Everest is the highest peak in the world.
Converse —A—The highest peak in the world is the Everest.

Obversion

Definition—Obversion is a form of immediate deductive inference where the predicate of the conclusion is the contradictory of the predicate of the premise, the subject being the same as that of the premise.

In this form of inference there is a legitimate change in the quality of a proposition. The premise of Obversion is called Obvertend and the conclusion is called Obverse.

Rules of Obversion :

1. The subject of the Obvertend becomes the subject of the Obverse and the contradictory of the predicate of the Obvertend becomes the predicate of the Obverse.

2. The quality of the Obverse is the opposite of the quality of the Obvertend.

3. The quantity of the Obvertend and the Obverse is the same.

4. The term which is not distributed in the Obvertend is not distributed in the Obverse.

The first rule is involved in the very definition of Obversion. Since the predicate is the contradictory of the original predicate while the subject remains the same, it is necessary that the quality be changed in order to retain the same meaning. The principles of Contradiction and Excluded Middle imply that the assertion of a quality of something is the logical equivalent of the denial of its contradictory and *vice versa* of the same thing. So we get equivalent propositions of the Obvertend in the Obverse. The fourth rule states the general principle of deductive inference.

Application of these rules leads to the following schema of bversion.

Obvertend		Obverse
A—All S is P.	=	No S is not-P—E.
E—No S is P.	=	All S is not-P—A.
I—Some S is P.	=	Some S is not not-P—O.
O—Some S is not P.	=	Some S is not-P—I.

Each proposition of the A, E, I, O form has an equivalent bverse. Since not-P does not occur in the premise, its being dis-ibuted or undistributed in the conclusion is not affected by the istribution or otherwise of P. Examples of significant obversion are :

Obvertend		Obverse
—All men are mortal	=	No men are non-mortal— E.
—No men are perfect	=	All men are non-perfect —A.
—Some men are honest	=	Some men are not non-honest—O.
—Some men are not reliable	=	Some men are non-reliable — I.

Bain is of opinion that "there are obverse inferences justified nly on an examination of the matter of the proposition." He names his form of inference as *Material Obversion*. Here the subject of the onclusion is the opposite of the subject of the premise, and the predicate of the conclusion is the opposite of the predicate of the premise. The quality, naturally, remains the same.

The following are the examples of Material Obversion :

Honest people are reliable.
∴ Dishonest people are unreliable.
Knowledge is good.
∴ Ignorance is bad.

Generally this form of inference is not admitted to be a valid form of Obversion. It obviously differs widely from formal Obversion. The subject of the formal obverse is the same as the subject of the obvertend, but here the subject of the conclusion is the opposite of the subject of the premise. The predicate of the formal obverse is the contradictory of the predicate of the obvertend, but here the predicate of the conclusion is either the contrary or the contradictory of the predicate of the premise. The quality of the obvertend and of the obverse in formal obversion is different, but here it is the same. Further, formal obversion has no need to make a reference to matter of fact; the inference is based on the principles of Contradiction and Excluded Middle. But in material obversion, knowledge of matters of fact is essential. So material obversion cannot be taken as a variation of formal obversion and is treated as fallacious.

Contraposition and Inversion

Conversion and Obversion are the two fundamental processes of Immediate Deductive Inference. Other forms of immediate deductive inference may be obtained by successively converting and obverting in either order. Two of these are given special names. They are Contraposition and Inversion.

Contraposition is that form of Immediate inference where the contradictory of the original predicate is the subject of the conclusion and the original subject or its contradictory is the predicate of the conclusion according as it is partial or complete respectively. The conclusion here is called Contrapositive. The partial contrapositive is obtained by first obverting a proposition and then converting the obverse. If it is further obverted, it yields complete contrapositive.

Inversion is that form of immediate inference where the contradictory of the original subject is the subject of the conclusion and either the original predicate or its contradictory is the predicate o the conclusion. The conclusion is called Inverse and the premise i called the Invertend. The conclusion is obtained by applying conversion and obversion alternatively, beginning with obversion firs in the case of A proposition and conversion first in the case of E proposition. Inversion may be Complete or Partial. In Complet inversion, the predicate of the inverse is the contradictory of th original predicate and in Partial inversion, the predicate of th inverse is the original predicate itself.

In order to find out the contrapositive and inverse of A, E, I, and O propositions, let us apply the processes of conversion and obversion alternatively beginning with obversion first.

	A—All S is P.	(Original proposition)
(Obv.)	E—No S is not-p.	(Obverse)
(Conv.)	E—*No not-P* is S.	(Converted obverse or partial Contrapositive)
(Obv.)	A—*All not-P is not-S.*	(Complete *Contrapositive*)
(Conv.)	I—*Some not-S is not-P.*	(*Complete inverse*)
(Obv.)	O—*Some not-S is not P.*	(*Partial inverse*)

O proposition cannot be converted.

	E—No S is P.	(Original proposition)
(Obv.)	A—All S is not-p.	(Obverse)
(Conv.)	I—*Some not-P is S.*	(Converted obverse or partial*Contrapositive*)
(Obv.)	O—*Some not-P is not not-S.*	(Complete *Contrapositive*)

O proposition cannot be converted.

	I—Some S is P.	(Original proposition)
(Obv.)	O—Some S is not not-P.	(Obverse)

O proposition cannot be converted.

So Contrapositive of I proposition is not possible.

	O—Some S is not P.	(Original proposition)
(Obv.)	I—Some S is P	(Obverse)
(Conv.)	I—*Some not-P is S.*	(Converted obverse or Partial Contrapositive)
(Obv.)	*O—Some not-P is not not-S.*	(Complete *Contrapositive*)

O proposition cannot be converted.

Now let us apply the process of Conversion and Obversion alternatively beginning with conversion first in order to obtain the inverse wherever possible.

	A—All S is P.	(Original proposition)
(Conv.)	I—Some P is S.	(Converse)
(Obv.)	O—Some P is not not-S.	(Obverted converse)

O proposition cannot be converted.

E—No S is P. (Original proposition)

(Conv.) E—No P is S. (Converse)

(Obv.) A—All P is not-S. (Obverted converse)

(Conv.) *I—Some not-S is P.* (*Partial inverse*)

(Obv.) O—*Some not-S is not not-P.* (*Complete inverse*)

O proposition cannot be converted.

I—Some S is P. (Original proposition)

(Conv.) I—Some P is S. (Converse)

(Obv.) O—Some P is not not-S. (Obverted converse)

O proposition cannot be converted.

O—Some S is not P. (Original proposition)

O proposition cannot be converted.

So in the case of I and O propositions we cannot find an inverse

The result of Eduction may be summarised thus :

Original proposition	Converse	Obverse	Partial Contrapositive	Complete Contraposi-tive	Partial inverse	Complete inverse
A	I	E	E	A	O	I
E	E	A	I	O	I	O
I	I	O	none	none	none	none
O	none	I	I	O	none	none

It may be noted that :

The subject of	the obverse	= the subject	of the premise
	the Converse	= the predicate	
	the contrapositive	= the contradictory of the predicate	
	the Inverse	= the contradictory of the subject	

The predicate of	the Converse & the Partial contrapositive	= the subject	of the premise.
	the Partial inverse	= the predicate	
	the Obverse & the Complete inverse	= the contradictory of the predicate	
	the Complete contrapositive	= the contradictory of the subject	

Further,

The quality of	the Converse, the Complete contrapositive & the Complete inverse	= the same as	the premise.
	the Obverse, the Partial contrapositive & the Partial inverse	= the opposite of	

Criticism of Immediate Inference

Mill and Bain are of opinion that the so-called immediate inferences are not at all inferences. Mill calls them "Inferences improperly so called." According to him, in these inferences "there is in the conclusion no new truth, nothing but what was already asserted in the premise." According to Bain, "In none of these cases, is there inference properly so called, that is to say, the transition from a fact to some different fact. There is merely transition from one wording to another wording of the same fact."

Other logicians like Welton, Coffey, Joseph,etc. are, however, of opinion that Immediate inference cannot be denied the status of inference. In every form of inference, the conclusion must be implied in the premise or premises. We cannot infer that the Sun is bright from Men are mortal. The conclusion only makes explicit what is implicit in the premises. Immediate inferences also surely do this. If the conclusion in these inferences were only a mere repetition of the premise,it is not likely that people would commit any fallacy in such inferences. But fallacies are not rare in these inferences, unless we pay due attention to the rules. So immediate inferences should be considered as inferences proper.

The objection raised by the Modern Logicians is of a more serious nature. It is pointed out that the partial inverse of All S is P is Some not-S is not P. Here P is not distributed in the premise, but it is distributed in the conclusion. Stebbing takes a significant example and shows that the complete inverse of 'All honest politicians are mortal' would be 'Some dishonest politicians are immortal.' Wherever the premise is true and the argument is valid, the conclusion must also be true. But here while the premise is true, the conclusion is false. So we cannot claim that the processes of Conversion and Obversion which we have applied here are valid processes of reasoning. Conversion and Obversion, however, do appear to be valid, and even other forms of reasoning are dependent on them. It is necessary, therefore,to examine the assumption on which the validity of these inferences rests. The assumption is that S, not-S, P and not-P all exist. If honest politicians, dishonest politicians, mortals and immortals would all exist, and if the honest politicians are wholly included in the class mortals, then the dishonest politician are bound to spread over mortals and immortals. But sinc 'immortals' is an empty class, the dishonest politicians are confine to only the class 'mortals' and the conclusion that some dishones politicians are immortals appears absurd. There is no reason, however, why some classes should not remain empty and in that case th assumption that the classes S, not-S, P and not-P are existent is a false assumption. Naturally,the conclusion of the above inversion is false, because it is based on a false assumption that 'immortals do exist.'

But it may again be argued that if an immediate inference is based on certain other assumptions besides the proposition taken as the premise, how does it become immediate then ? If immediate inference is defined as an inference following from a single proposition only, without any further assumption, then Conversion, Obversion,etc., are either immediate inference in this sense but not valid or valid but not immediate inference.

Further, it is pointed out that universal propositions are existentially negative whereas the particular propositions are existentially affirmative. We are not justified in inferring what is existentially affirmative from what is existentially negative. So no particular proposition, which implies the existence of the subject term, can be inferred from universal proposition which does not imply the existence of the subject term. So conversion of A to I, contraposition of E to I and inversion of A and E to I and O are not valid.

EXERCISE

1. What is the nature of inference ? Distinguish between :
    (a) Deductive and Inductive inference
    (b) Immediate and mediate inference
    (for Answer, refer also to Chapter-I)
2. What is Conversion ? State and explain its rules and determine the converse of A, E, I and O propositions.
3. What is the difference between Simple Conversion and Conversion per accidens ? Is it possible to convert an O proposition ? Is it possible to have simple conversion of an A proposition ?
4. What is Obversion ? State and explain its rules and determine the Obverse of A, E, I and O propositions.

5. Write notes on :
   - (a) Material Obversion
   - (b) Conversion by negation.

6. What is Contraposition ? How is it related to Conversion and Obversion ? Find out the Contrapositive of the following propositions :
   - (a) Lion is always ferocious.
   - (b) Every beast is not carnivorous.
   - (c) Few snakes are not poisonous.
   - (d) God-fearing men are never dishonest.

7. Distinguish between Partial and Complete Inversion and determine by the processes of conversion and obversion either kind of inverse in the following cases wherever possible.
   - (a) Living beings are not immortal.
   - (b) Every citizen of Orissa is an Indian.
   - (c) Most Christians are not Indians.
   - (d) Some educated men are dishonest.

8. Find the obverted converse and obverted contrapositive of the following :
   - (a) Some flowers are not-white.
   - (b) All animals are mortal.
   - (c) No non-Oriyas of this locality are non-educated.
   - (d) Few gazetted Officers are not reliable.

9. Is immediate inference an inference proper ? Comment on the remarks that "Immediate inference is either immediate or valid, but not both immediate and valid."

10. Test the following :
   - (a) All mangoes are not sweet. So all sweet things are not mangoes.
   - (b) Only the virtuous are happy. So all happy people are virtuous.
   - (c) No Americans are illiterate. So no non-Americans are literate.
   - (d) Some politicians are liars. So some non-politicians are not liars.
   - (e) All educated persons are mortals.

     ∴ Some uneducated persons are not-mortals.

(mediate inference)

7

Syllogism

Nature of Syllogism

In immediate inference the conclusion is derived from a proposition taken as premise. So in some cases the inference appears trivial and as a mere change of form of expression of a proposition. In mediate inference, where the conclusion is derived from more than one premise, the mark of inference, *i.e.*, acquiring knowledge not contained in any premise taken separately is patent and the conclusion cannot be said to be trivial.

Syllogism is a mediate deductive inference in which the conclusion is derived from the conjoint assertion of two premises. Johnson defines syllogism as "an argument containing *two premises* and a *conclusion* involving between them *three terms*, *each* of which occurs in two different propositions." According to Joseph, "A syllogism is actually an argument in which from the given relation of two terms, *in the way of subject and predicate* to the same third term, there follows necessarily a relation *in the way of subject and predicate*, between those two terms themselves."

The following characteristics of the syllogism are worthy of being noted :

1. A syllogism consists of three propositions two of which are the premises and the other is the conclusion. This characteristic distinguishes syllogism from the immediate inference. In immediate inference the conclusion is derived from one single premise, but in syllogism one premise is incapable of giving the conclusion without the mediation of the other. Thus, for example, in the syllogism, 'All

men are mortal; Gopal is a man; therefore Gopal is mortal', we cannot get the conclusion–'Gopal is mortal', from the premise – 'All men are mortal' only, since Gopal might have been a ship or something else. Similarly, 'Gopal is a man' by itself cannot give us the conclusion 'Gopal is mortal' unless men be mortal. But the joint assertion of 'All men are mortal' and 'Gopal is a man' necessarily leads to the conclusion that Gopal is mortal.

2. The conclusion of a syllogism is said to be hypothetically necessary in character. The relation between the premises and the conclusion is like that between the antecedent and the consequent of a hypothetical proposition. We cannot affirm the premises and at the same time deny the conclusion. The conclusion necessarily follows from the premises, but this necessary connection is based on the implication rather than on their truth. Of course, when the premises are materially true, the conclusion is bound to be materially true, but our concern in a syllogism is not to examine whether the premises are true or not, but to examine what else must be true *if* the premises be true. If Ram is as old as Hari and Hari is as old as Jadu, then Ram must be as old as Jadu. Thus syllogism asserts that if the first two propositions be true, the third proposition is bound to be true. It does not assert that there are three such boys bearing these names and they are of the same age.

3. The syllogism is a deductive reasoning and as such the conclusion is never more general than the premises. The conclusion, to be valid, can never go beyond evidence. In a syllogism, whatever is predicated of a class is predicated of things contained in that class. So the conclusion may be as general as or less general than the premises, but cannot be more general than them. It follows from this that no undistributed term of the premise can be distributed in the conclusion.

The highest mountain peak is in India.
The Everest is the highest mountain peak.
∴ The Everest is in India.

Here the conclusion is as general as the premises.

All men are mortal.
All students are men.
∴ All students are mortal.

Here the conclusion is less general than the major premise.

Structure of Syllogism

An analysis of the structure of a syllogism shows that though it contains three propositions the number of terms is not six, but three. Each term is used twice. Two of the propositions are the premises or the implicans. The third which follows from or implied in them is called the conclusion or the implicate. The subject of the conclusion is called the Minor term. The predicate of the conclusion is called the Major term. The other term, which occurs in both the premises but not in the conclusion, is called the Middle term. The premise, in which the minor term occurs, is called the Minor Premise; and the premise, in which the Major term occurs, is called the Major Premise. Let us take a symbolical example to illustrate these.

All M is P.
All S is M.
∴ All S is P.

Obviously, 'All S is P' is the conclusion in this case and the other two propositions are the premises. Here S is the minor term, P is the major term and M is the middle term. 'All M is P' is the major premise and 'All S is M' is the minor premise.

The Traditional Logicians, who constructed the typical example of a syllogism with three A propositions, found that the subject of the conclusion is of the least denotation and thus it is called the minor term; the predicate of the conclusion is of the widest denotation and thus it is called the major term. These are also called the extremes. The denotation of the middle term is in between the denotations of the major and the minor terms. The following example will justify this contention.

All men are mortal beings.
All students are men.
∴ All students are mortal beings.

Here the minor term 'student' has the least denotation, the major term 'mortal being' has the widest denotation and the middle term 'man' has an intermediary denotation.

It is not true, however, that in all syllogisms this order of denotation is the case, but these names are used in a technical sense. The middle term may not be of intermediary denotation, but it does mediate between the extremes in order to derive the conclusion of which the extremes are the extremities.

From the relation of the middle term with the major term in the major premise, and with the minor term in the minor premise, a relation between the major term and the minor term is established in the conclusion.

So the middle term occurs in both the premises, but not in the conclusion. The major term occurs in the major premise and the conclusion. And the minor term occurs in the minor premise and the conclusion.

In ordinary discourse, the propositions of a syllogism may be stated in any order. But it is customary to express the Major premise first, the Minor premise next and lastly the Conclusion. This order of statement of the propositions is recognised as the logical form of a syllogism.

Figure of Syllogism

Figure is the form of a syllogism as determined by the positio of the middle term in the premises. The middle term may be subjec in both the premises or predicate in both the premises or subject i the major premise and predicate in the minor premise or predicat in the major premise and subject in the minor premise. There ca be only four possible arrangements of the middle term in th premises. So there are four figures.

If the middle term be symbolised as M, the minor term as S, e major term as P and the syllogism be stated in the logical form, e., the major premise first, the minor premise next and lastly the onclusion, the four figures may be expressed thus-:

Fig I
$$\begin{array}{cc} M & P \\ S & M \\ \hline S & P \end{array}$$

Fig II
$$\begin{array}{cc} P & M \\ S & M \\ \hline S & P \end{array}$$

Fig III
$$\begin{array}{cc} M & P \\ M & S \\ \hline S & P \end{array}$$

Fig IV
$$\begin{array}{cc} P & M \\ M & S \\ \hline S & P \end{array}$$

If the syllogism is in logical order, in the first figure, the middle term is first in the first premise and second in the second premise; in the second figure, it is second in both the premises. The third figure is opposite of the second, and the fourth is opposite of the first in respect of the position of the middle term.

The figures may be defined thus : The first figure is that form of the syllogism in which the middle term is the subject in the major premise and the predicate in the minor premise.

The second figure is that form of the syllogism in which the middle term is the predicate in both the premises.

The third figure is that form of the syllogism in which the middle term is the subject in both the premises.

The fourth figure is that form of the syllogism in which the middle term is the predicate in the major premise and the subject in the minor premise.

The difference in the figures of a syllogism cannot be ignored. It will be seen later that a form of argument in one figure may be valid, while the same form of argument in another figure may be invalid.

Thus for example,
All M is P
All S is M
∴ All S is P is a valid argument.
But All P is M
All S is M
∴ All S is P is an invalid argument.

Mood of Syllogism

Mood is the form of a syllogism as determined by the qualit and the quantity of the constituent two premises or the thre propositions.

From the standpoint of quality and quantity, propositions ar of four types, viz., A, E, I and O. The mood of a syllogism determined when we state the type of propositions used as premis with or without mentioning the conclusion.

The term 'mood' has been used in three different senses.

Firstly, mood is defined as the form of a syllogism as determin by the quality and quantity of the constituent premises. In this sens there are sixteen possible moods in each figure and 16 × 4 = possible moods in all. In each figure they are :

AA	EA	IA	OA
AE	EE	IE	OE
AI	EI	II	OI
AO	EO	IO	OO

Secondly, mood is defined as the form of a syllogism as de mined by the quality and quantity of all the three constitu propositions taking into account not only the premises but also the conclusion. In this sense, each of the above 64 moods would give rise to four different moods. As for example, from AA in figure I we may have four forms, viz.,

AAA
AAE
AAI
and AAO

So all told, in this sense, there are 64 × 4 =256 moods.

Thirdly, mood is defined in a highly restricted sense to mean only those combinations which yield valid conclusions. In this sense, only 19 out of the 64 moods in the first sense or 24 out of the 256 moods in the second sense are valid. Only these are considered to be moods in the third sense.

In order to determine which 19 out of the 64 or which 24 out of the 256 possible moods are valid, traditional logicians have suggested mainly three methods. They are :

1. Application of general syllogistic rules.
2. Application of special syllogistic rules.
3. Application of Aristotle's Dictum and reduction.

General Syllogistic Rules

Usually ten different rules are prescribed by logicians to which a syllogism must conform in order to be valid. These are called the General Syllogistic Rules. They may be stated as follows :

1. Every syllogism must have three and only three terms.
2. Every syllogism must have three and only three propositions.
3. The middle term must be distributed at least once.
4. An undistributed term of the premise cannot be distributed in the conclusion.
5. From two negative premises no conclusion can be drawn.

6. If one premise be negative, the conclusion must be negative.
7. If both premises be affirmative, the conclusion must be affirmative.
8. From two particular premises no conclusion can be drawn.
9. If one of the premises be particular, the conclusion mus be particular.
10. If the major premise be particular and the minor premis be negative, no conclusion can be drawn.

It may be seen that the first two of these are not, properl speaking, rules; they are rather the defining characteristics of th syllogism.

The next four (3 to 6) are worthy of being called rules. The la four (7 to 10) are merely deductions from these rules. Stebbing cal Rules 3 and 4 Axioms of Distribution and the next three, i.e., rules 6 and 7 Axioms of Quality. The last three she calls Corollaries Theorems. Those logicians who call all these to be rules also agree th all of them are not of equal status. The first six are said to be Prima Rules and the last four are said to be Secondary Rules. Violation any of these last four rules is the result of violation of one or other the Primary Rules.

Let us study the General Syllogistic Rules one by one.

Rule 1 : *Every syllogism must have three and only three terms.*

If there be less than three terms, we cannot get a mediate fo of inference. With two terms we may at best construct an immedi inference, but not a syllogism. When there are more than th terms in a statement, it is either not an inference at all or it is a tr of reasoning. "The Sun is bright and Men are mortal" contains f terms, but it cannot be said to be an inference, because nothing be inferred from such a combination.

All animals are mortal.
All men are animals.
All saints are men.
∴ All saints are mortal.

Here there are more than three terms and surely this may be alled a mediate inference; it is, however, not *one* syllogism but a ombination of two syllogisms expressed in an abbreviated form. hey are :

1. All animals are mortal.
All men are animals.
∴ All men are mortal.

2. All men are mortal.
All saints are men.
∴ All saints are mortal.

It is evident from the above that a syllogism must have three nd only three terms, viz, middle, major and minor.

Sometimes it appears that we may get a conclusion though here be four terms in the premises.

e.g., All crows are black.
All cranes are white.
∴ No cranes are crows.

This argument is fallacious though all the propositions are, as matter of fact, true, since the conclusion cannot be said to be erived from the premises. There being no middle term here, it is ot possible to establish any relation, by the inferential process lone between the extremes. The fallacy committed in such a case s called the fallacy of four terms.

This fallacy is also committed when one term is used in two ifferent senses. In such cases, apparently there are only three erms, but one term is used equivocally.

g., Crown is the head-wear of a king.
Crown is worth five shillings.
∴ The head-wear of a king is worth five shillings.

The fallacy in this case is also called the fallacy of equivocatio But this is only a variation of the fallacy of four terms.

Rule 2 : *Every syllogism must have three and only three propos tions.*

In every syllogism there are three terms and each term is use twice. So naturally there are three propositions. These thre propositions are not always explicitly stated. But if in an inferen all the propositions are explicitly stated and the total number propositions be two, then it is not a syllogism but an immedia inference. If in an inference the number of propositions be mo than three, then either some propositions are irrelevant or t inference is really a train of reasonings.

Ram is a man.
∴ Ram is mortal.

Here there are three terms and it is an abbreviated syllogis where the major premise has been kept unexpressed. If the maj premise 'All men are mortal' be explicitly stated, it would becom syllogism containing three propositions.

All men are mortal.
∴ Some mortal beings are men.

Here there are only two terms and two propositions. This is n a syllogism but an immediate inference, viz., Conversion.

All animals are mortal.
All men are mortal.
Ram is a man.
∴ Ram is mortal.

Here there are four terms and four propositions. But t proposition 'All animals are mortal' is irrelevant. If we ignore it, t remaining will be a syllogism having only three propositions.

All animals are mortal.
All men are animals.
Ram is a man.
∴ Ram is mortal.

Here there are four terms and four propositions. However, it is not a single syllogism but a combination of two syllogisms abbreviated, viz.,

1. All animals are mortal.
All men are animals.
∴ All men are mortal.

2. All men are mortal.
Ram is a man.
∴ Ram is mortal.

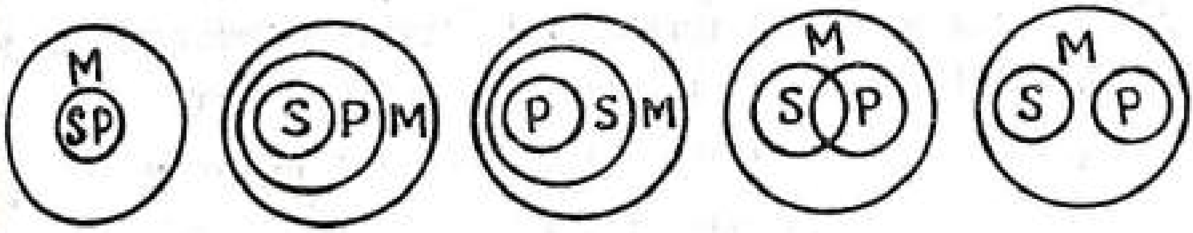
We conclude that a syllogism cannot have less or more than three propositions. It must have three and only three propositions.

Rule 3 :: *The middle term must be distributed at least once.*

It means that the middle term must be used in its entire denotation at least once in the premises. If in both the premises, it is only partially taken, then there remains the possibility that the major term and the minor term have been related with different parts of the middle term which will then fail to serve its purpose of mediation between the major term and the minor term.

All P is M.
All S is M.

Here the middle term M is not distributed. So if these two propositions be taken as premises, it is not possible to determine the relation between S and P, because whatever be the relation between S and P, they may both be included in M.

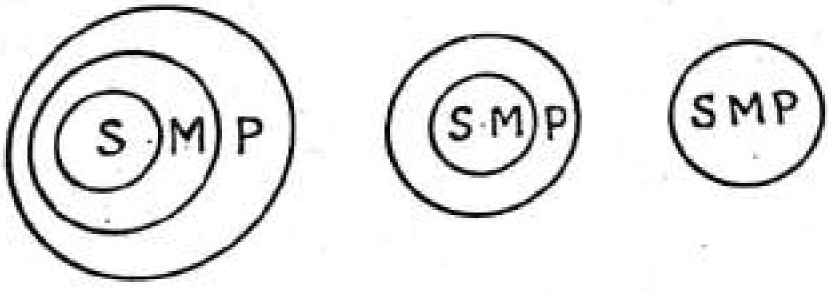


In all these cases All P is M and All S is M are true, but the relation between S and P is different in different cases. So if All P is M and All S is M be taken as premises, the conclusion is : Either All S is P or No S is P or Some S is P or Some S is not P. This is no inference at all, because we are asserting nothing in the conclusion.

Let us take an example where the middle term M is distributed once in the premises.

All M is P.
All S is M.

Here M is distributed in the first premise, but not distributed in the second premise. These propositions can be represented by the following diagrams.



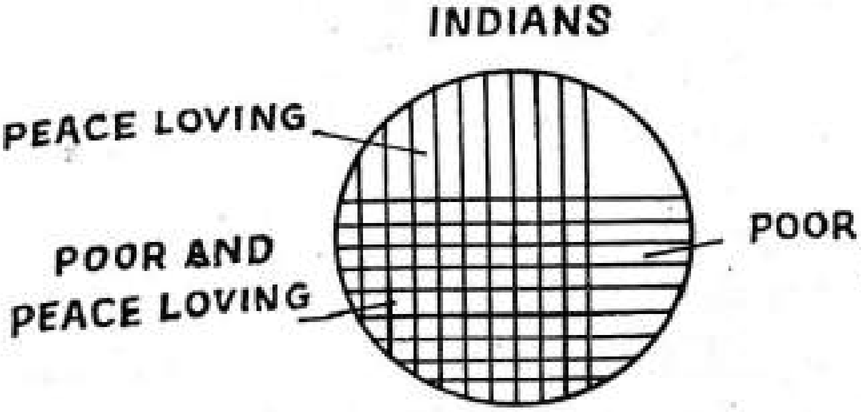
In every case we can assert that All S is P. So the conclusion from the above two premises is All S is P.

If the middle term is distributed in both the premises, it i possible to determine the relation between the major and the mino term. But it is not possible to draw any conclusion when it is not a all distributed. The fallacy that arises in such a case is called th fallacy of undistributed middle.

In one special circumstance, however, it is possible to draw conclusion, though the middle term is not at all distributed. Whe the argument is in Fig. III, i.e., the middle term is subject in both th premises and both the premises are plurative propositions, i.e more than half of the denotation of the middle term is taken in either case, there remains a common bond between the major term and the minor term.

Most M is P.
Most M is S.
∴ Some S is P.
Most Indians are peace-loving.
Most Indians are poor.
∴ Some poor people are peace-loving.

This argument can be represented by the following diagram :



Here both the propositions being I, no term is distributed. So the middle term is not at all distributed. But since it is asserted that more than half of the Indians are peace-loving and more than half of the Indians are poor, the conclusion that some poor people are peace-loving is inevitable.

Rule 4 : *An undistributed term of the premise cannot be distributed in the conclusion.*

Syllogism is a deductive inference and so its conclusion is never more general than the premises. In deductive inference the implication in the premises is only drawn out and made explicit in the conclusion. Nothing extraneous is stated in the conclusion which is not implied by and contained in the premises. So if a term is not distributed in the premise, i.e; if it is taken only in partial extent, it cannot be distributed in the conclusion, i.e., it cannot be taken in its whole extent. The violation of this rule leads to the fallacy of illicit process of the major or the minor term according as the major or the minor term is so distributed in the conclusion.

It is to be noted that there is no fallacy when a term is distributed or undistributed both in the premise and in the conclusion. There is also no fallacy when a term is distributed in the premise but not distributed in the conclusion. The fallacy of the illicit process arises only when a term is undistributed in the premise but distributed in the conclusion. There is no fallacy if less is taken in the conclusion. The fallacy arises only if more is taken.

No M is P.
All M is S.
∴ No S is P.
No men are quadruped.
All men are animals.
∴ No animals are quadruped.

Here we commit the fallacy of illicit minor,because the minor term (S, animals) is distributed in the conclusion without being distributed in the minor premise.

All M is P.
No S is M.
∴ No S is P.
All men are mortal.
No beasts are men.
∴ No beasts are mortal.

Here we commit the fallacy of illicit major, because the major term (P, mortal) is distributed in the conclusion without being distributed in the major premise.

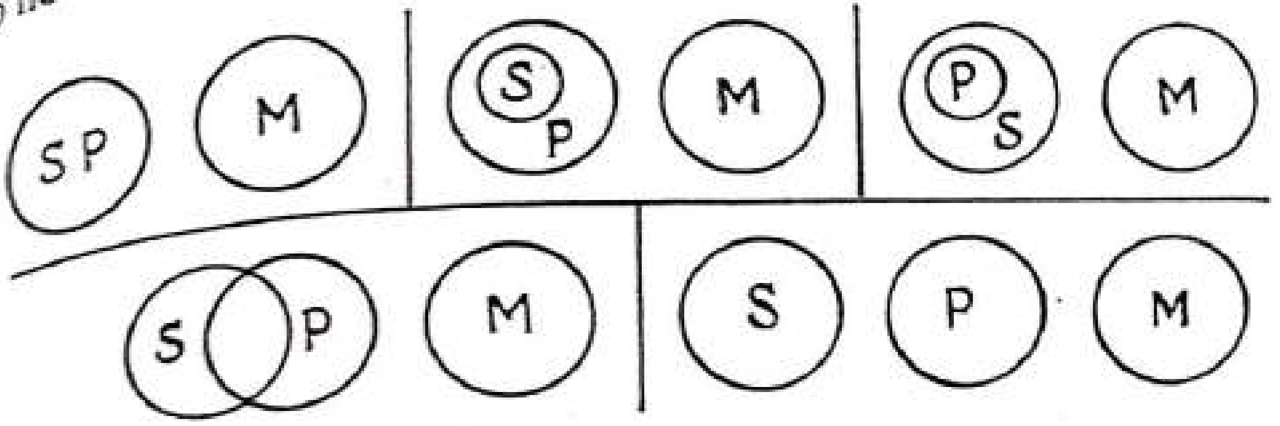
Rule 5 : *From two negative premises no conclusion can be drawn.*

A Negative proposition states that the terms are excluded from each other. So if both the premises be negative, it only means that both the minor and the major terms are excluded from the middle term. From this it is not possible to know as to how they are related

Whatever be their mutual relation, they can both be excluded from the middle term.

No P is M.
No S is M.

These propositions can be asserted in each of the following cases, but the relation between S and P is different in different cases. So no conclusion can be drawn.



If we draw any conclusion in a syllogism where both the premises are negative, the fallacy that arises is called the fallacy of two negative premises.

e.g., No beasts are immortal.
No cats are immortal.
∴ No cats are beasts.

Rule 6 : *If one premise be negative, the conclusion must be negative.*

If one premise be negative, the other premise must be affirmative, since from two negative premises no conclusion follows. The negative premise states that the middle term and one of the extremes are excluded from each other, but the affirmative premise states that the middle term and the other extreme have a relation of inclusion between them. So from these two premises the only possible conclusion is that the extremes are partially or wholly excluded from each other.

M is not P or P is not M.
but M is S or S is M.
So the only possible conclusion is S is not P.

The quantity of the conclusion, of course, depends on the quantity of the premises, and the validity of the inference on the distribution of the middle term. In any case, the conclusion, if any, must be negative.

The converse of this rule, i.e., 'If the conclusion is negative one of the premises must be negative' is also true. The negative conclusion states that there is a relation of exclusion between the extremes. If both the extremes are included in or excluded from the middle term, no conclusion follows (see the diagrams in Rules 3 and 5 on pages 135 & 139). If the middle term includes one and is itself included in the other, then one of the extremes will be included in the other. So to have the relation of exclusion the middle term must include one (affirmative premise) and be excluded from the other (negative premise). Thus when the conclusion is negative, one premise must have been affirmative and the other premise must have been negative.

Rule 7 : *If both premises be affirmative, the conclusion must be affirmative.*

The affirmative premises state that the middle term has a relation of inclusion with the extremes. So if the middle term is taken at least once in its entire extent to satisfy the condition of Rule 3, the extremes must have a relation of inclusion whether partial or complete, in this case.

This rule can be indirectly proved thus.

The converse of Rule 6 states, 'If the conclusion is negative one of the premises must be negative.' Here *ex hypothesi*, both the premises are affirmative. So the conclusion cannot be negative. Therefore, if at all, the conclusion must be affirmative.

The converse of this rule, i.e., 'If the conclusion is affirmative, both the premises must have been affirmative' is also true. The premises must have been either both negative or one negative and the other affirmative or both affirmative. In the first case no conclusion follows; in the second case the conclusion is negative. So the only possibility for having an affirmative conclusion is that the premises be both affirmative.

Rule 8 : *From two particular premises no conclusion can be drawn.*

If both the premises are particular, they are either II or OO or IO or OI. In the combination II no term is distributed. So the middle term cannot be distributed even once in the premises and thus we commit the fallacy of undistributed middle here. OO combination commits the fallacy of two negative premises. In each of the combinations IO and OI, only one term, i.e., the predicate of O is distributed. It must be the middle term since otherwise we commit the fallacy of undistributed middle. But here one premise being negative, the conclusion must be negative and the major term is distributed. There being no other distributed term in the premises, the major term will be undistributed in the premise but distributed in the conclusion, thus leading to the fallacy of illicit major. So from two particular premises no conclusion can be drawn.

In one special circumstance, however, it is possible to draw a conclusion though both the premises are particular. When the argument is in Fig. III and both the premises are plurative propositions, we can draw a conclusion from two particular premises. (See the diagram in Rule 3, page 137)

When both the premises are particular and we draw a fallacious conclusion, the fallacy is also called the fallacy of two particular premises.

Rule 9 : *If one premise be particular, the conclusion must be particular.*

When one premise is particular, the other premise must be universal, since from two particular premises no conclusion can be drawn. So the combinations are IA, IE, OA and OE in either order of the premises.

Of these, OE in either order gives no conclusion, since both the premises are negative.

IA in any order distributes only one term, i.e., the subject of A. In order to avoid the fallacy of undistributed middle this distributed term must be the middle term. No other term is distributed in the premises and so no term can be distributed in the conclusion. Both the premises being affirmative, the conclusion here must be affirmative, i.e., either A or I. But it cannot be A, because in that case the subject of A, the minor term, will be distributed in the conclusion without being distributed in the premise thus giving rise to the fallacy of illicit minor. So the conclusion, if any, is bound to be I.

In IE in either order and OA in either order two terms are distributed in each case, i.e., both the subject and predicate of E in the first combination and the predicate of O and subject of A in the second combination. One of these distributed terms must be the middle term in order to avoid the fallacy of undistributed middle. So only one more term is left distributed in the premises which can be distributed in the conclusion. The conclusion in each of these combinations must be negative, i.e., E or O, since one of the premises in each case is negative. It, however, cannot be E because E distributes two terms, but only one term is left distributed in the premises. So wherever possible the conclusion can only be O.

From the above discussion, it is clear that if one premise be particular, the conclusion can be either I or O, i.e., particular.

The converse of this rule, i.e., 'If the conclusion is particular, one of the premises must be particular' is not true. Syllogism being a deductive inference, the premise may be more general than the conclusion. A term may be distributed in the premise without being distributed in the conclusion. No fallacy is involved in doing so. So when the conclusion is particular, we cannot say that a premise must be so.

If, however, the conclusion is universal, the premises are bound to be universal, because if anyone of them is particular, the conclusion becomes particular; and if both of them are particular, no conclusion can be drawn.

'A universal conclusion requires that the premises must be universal'—this rule can also be proved otherwise.

If the conclusion is universal, it is either A or E.

When the conclusion is A, it being affirmative, both the premises must be affirmative, i.e., A or I. Since the minor term is distributed in the conclusion, it must be distributed in the premise to avoid the fallacy of illicit minor. Besides this, the middle term must be distributed in the premise at least once to avoid the fallacy of undistributed middle. So atleast two terms are required to be distributed in the premises. This is not possible if any premise be I. So both the premises must be A, i.e., universal.

When the conclusion is E, it being negative, one of the premises must be negative, i.e., E or O and the other premise must be affirmative, i.e., A or I. The E-conclusion distributes two terms and they need to be distributed in the premises to avoid the fallacies of illicit process. Besides them the middle term must be distributed in the premise at least once to avoid the fallacy of undistributed middle. So at least three terms are required to be distributed in the premises. This is not possible except when the premises are EA or AE.

So when the conclusion is universal, the premises must be universal.

Rule 10 : *If the major premise be particular and the minor premise be negative, no conclusion can be drawn.*

If the minor premise be negative, the major premise must be ffirmative and the conclusion must be negative. The negative onclusion distributes its predicate, the major term. But this cannot e distributed in the major premise, since it is both particular and ffirmative, i.e., an I proposition which distributes no term. Thus if ny conclusion is drawn in such a combination, there arises the allacy of illicit major. So no conclusion follows from a particular major and negative minor.

Determination of Valid Moods by the Application of General Syllogistic Rules

If we take the quality and quantity of the premises only, we get sixteen possible moods in each figure. They are :

AA	EA	IA	OA
AE	EE	IE	OE
AI	EI	II	OI
AO	EO	IO	OO

Of these, EE, EO, OE and OO are invalid in every figure, because they commit the fallacy of two negative premises, by violating Rule 5. II, IO and OI are invalid in every figure, because they commit the fallacy of two particular premises by violating Rule 8. The mood IE is also invalid in every figure, because it violates Rule 10 and is sure to commit the fallacy of illicit major. The remaining eight moods, viz., AA, AE, AI, AO, EA, EI, IA and OA can possibly be valid. We shall see that all of them are not valid in all figures.

Let us test each of these eight moods in every figure and determine which of them are valid in which figure. While testing these moods it is necessary to remember that A distributes the subject, E distributes both the subject and the predicate; I distributes neither, and O distributes the predicate.

Figure I

All M is P. All men are mortal.
All S is M. All students are men.

Here both the premises are affirmative. So the conclusion, i any, must be affirmative i.e., A or I.

(a) A—All M is P. All men are mortal—A.
A—All S is M. All students are men—A.
∴ A—All S is P. ∴ All students are mortal—A.

Here the middle term (M, men) is distributed. So it is free from the fallacy of undistributed middle. In the conclusion the minor term (S, students) is distributed, and it is also distributed in the minor premise. So it is free from the fallacy of illicit minor. The major term

(P, mortal) is not distributed in the conclusion; so the question of the fallacy of illicit major does not arise. Therefore, AAA is a valid mood of Fig. I; it is technically called Barbara (which contains three vowels—AAA representing the three propositions).

(b) A—All M is P. All men are mortal— A.
A— All S is M. All students are men—A.
∴ I— Some S is P. ∴ Some students are mortal—I.

This, like (a), is free from the fallacies of undistributed middle and illicit major. The minor term (S, students) is distributed in the premise but not distributed in the conclusion. But this is not fallacious in deductive logic. So the mood AAI is valid in Fig. I. This is technically called Barbari (which contains the vowels AAI).

The conclusion of Barbara is the universal A proposition, whereas the conclusion of Barbari is the corresponding particular I proposition from the same premises. So Barbara is the main mood of which Barbari is the weakened mood. I may be derived from A by subalternation. So Barbari is also said to be the subaltern mood of Barbara.

2. AE—All M is P. All men are mortal.
No S is M. No beasts are men.

Here one premise is negative. So the conclusion, if any, must be negative,i.e., E or O.

(a) A—All M is P. All men are mortal—A.
E—No S is M. No beasts are men—E.
∴ E—No S is P. ∴ No beasts are mortal—E.

Here the middle term (M, men) is distributed in both the premises. So it is free from the fallacy of undistributed middle. The minor term (S, beasts) is distributed in both the conclusion and the minor premise. So it is free from the fallacy of illicit minor. But the major term (P, mortal) is distributed in the conclusion without being distributed in the major premise. So it commits the fallacy of illicit major.

(b) A—All M is P. All men are mortal-A.
E—No S is M. No beasts are men-E.
∴ O—Some S is not p. ∴ Some beasts are not mortal—O.

This also like (a) commits the fallacy of illicit major.

AE mood is therefore, invalid in Fig. I.

3. AI—All M is P.	All men are mortal.
Some S is M.	Some animals are men.

Here both the premises are affirmative and one premise i particular. So the conclusion, if any, must be particular affirmativ i.e., I.

A—All M is P.	All men are mortal—A.
I—Some S is M.	Some animals are men—I.
∴ I—Some S is P.	∴ Some animals are mortal—I.

Here the middle term (M, men) is distributed in the majo premise. So it is free from the fallacy of undistributed middle. The minor term (S,animals) and the major term (P, mortal) are no distributed in the conclusion. So the question of the fallacies of illici minor and illicit major does not arise. Therefore, AII is a vaild mood of Fig. I. It is technically called Darii (which contains the vowels AII).

4. AO—All M is P.	All men are mortal.
Some S is not M.	Some animals are not men.

Here one premise is particular and negative. So the conclusion, if any, must be particular negative, i.e., O.

A—All M is P.	All men are mortal—A.
O—Some S is not M.	Some animals are not men—O.
∴ O—Some S is not P.	∴ Some animals are not mortal—O.

Here the middle term (M, men) is distributed in both the premises. So it is free from the fallacy of undistributed middle. The minor term (S, animals) is not distributed in the conclusion. So the question of the fallacy of illicit minor does not arise. But the major term (P, mortal) is distributed in the conclusion without being distributed in the major premise. So it commits the fallacy of illicit major.

AO mood, therefore, is invalid in Fig. I.

5. EA—No M is P.	No men are perfect.
All S is M.	All students are men.

Here one premise is negative. So the conclusion, if any, must e negative, i.e. E or O.

(a) E—No M is P. — No men are perfect—E.
A—All S is M. — All students are men—A.
∴ E—No S is P. — ∴ No students are perfect—E.

Here the middle term (M, men) is distributed in the major remise. So it is free from the fallacy of undistributed middle. The inor term (S, students) is distributed in both the conclusion and he minor premise. So it is free from the fallacy of illicit minor. The ajor term (P, perfect) is distributed in both the conclusion and the ajor premise. So it is free from the fallacy of illicit major. Therefore, AE is a valid mood of Fig. I. It is technically called Celarent (which ontains the vowels EAE).

(b) E—No M is P. — No men are perfect—E.
A—All S is M. — All students are men—A.
∴ O—Some S is not P. — ∴ Some students are not perfect—O.

This also like (a) is free from all fallacies. The minor term (S, udents) is distributed in the minor premise, but not distributed in e conclusion. But this is not fallacious in deductive logic. So the ood EAO is valid in Fig. I. It is technically called Celaront (which ontains the vowels EAO).

Celarent is the main mood of which Celaront is the weakened r subaltern mood.

EI—No M is P. — No men are perfect.
Some S is M. — Some animals are men.

Here one premise is negative and the other premise is particular. the conclusion, if any, must be particular negative, i.e., O.

E—No M is P. — No men are perfect—E.
I—Some S is M. — Some animals are men—I.
O—Some S is not P. — ∴ Some animals are not perfect—O.

Here the middle term (M, men) is distributed in the major emise. So it is free from the fallacy of undistributed middle. The inor term (S, animals) is not distributed in the conclusion. So the estion of the fallacy of illicit minor does not arise. The major term

(P, perfect) is distributed both in the conclusion, and in the majo premise. So it is free from the fallacy of illicit major. Therefore, EI is a valid mood of Fig I. It is technically called Ferio (which contair the vowels EIO).

7. IA—Some M is P. Some men are illiterate.
All S is M. All students are men.

Here both the premises are affirmative and one premise particular. So the conclusion, if any, must be particular affirmativ i.e., I.

I—Some M is P. Some men are illiterate—I.
A—All S is M. All students are men—A.
∴ I—Some S is P. ∴ Some students are illiterate—I.

Here the middle term (M, men) is not at all distributed in th premises. So it commits the fallacy of undistributed middle.

Therefore, IA is not a valid mood in Fig. I.

8. OA—Some M is not P. Some men are not literate.
All S is M. All students are men.

Here one premise is particular and negative. So the conclusio if any, must be particular negative, i.e. O.

O—Some M is not P. Some men are not literate—O.
A—All S is M. All students are men—A.
∴ O—Some S is not P. ∴ Some students are not literate—

Here the middle term (M, men) is not at all distributed in t premises. So it commits the fallacy of undistributed middle.

Therefore, OA is not a valid mood in Fig. I.

From the above discussion, it is clear that in Fig. I, *four* m moods, viz.,

AAA—Barbara
EAE—Celarent
AII—Darii
EIO—Ferio

and *two* weakened or subaltern moods, *viz.*,

AAI—Barbari
EAO—Celaront

are valid. All other moods of this figure are invalid.

Similarly, we can test the moods of the other figures.

igure II AA—All P is M. All men are biped.
All S is M. All birds are biped.

Here both the premises being affirmative, the conclusion, if y, must be affirmative, i.e., A or I.

But the middle term is not at all distributed in the premises. So ommits the fallacy of undistributed middle. Therefore, AA is not lid in Fig. II.

AE—All P is M. All men are biped.
No S is M. No beasts are biped.

Here, one premise is negative. So, the conclusion must be gative, i.e. E or O.

(a) A—All P is M. All men are biped—A.
E—No S is M. No beasts are biped—E.
∴ E—No S is P. ∴ No beasts are men—E.

Here, the middle term is distributed in the minor premise. So, free from the fallacy of undistributed middle. The minor term istributed in both the conclusion and the minor premise. So it is from the fallacy of illicit minor. The major term is distributed oth the conclusion and the major premise. So, it is free from the cy of illicit major.

Therefore, AEE is a valid mood of Fig. II. It is technically d Camestres.

(b) A—All P is M. All men are biped—A.
E—No S is M. No beasts are biped —E.
∴ O—Some S is not P. ∴ Some beasts are not men—O.

Like (a), it is free from all fallacies. The minor term (S, beasts) tributed in the minor premise and not distributed in the conon, but this is not fallacious.

Therefore, the mood AEO is valid in Fig. II. It is technically d Camestrop.

Camestres is the main mood and Camestrop is its weakened or subaltern mood.

3. **AI**—All P is M.	All crows are black.
Some S is M.	Some dogs are black.

Here, both the premises being affirmative and one premise being particular, the conclusion, if any, must be particular affirmative, i.e., I.

But the middle term is not at all distributed in the premises. So it commits the fallacy of undistributed middle. Therefore, AI is no valid in Fig. II.

4 **AO**– All P is M.	All men are biped.
Some S is not M.	Some animals are not bipe

Here, one premise is particular and negative. So, the conclusion, if any, must be particular negative, i.e., O.

A–All P is M.	All men are biped–A.
O–Some S is not M.	Some animals are not biped–O
∴ O–Some S is not P.	∴ Some animals are not men–O.

Here, the middle term (M, biped) is distributed in the min premise. So it is free from the fallacy of undistributed middle. Th minor term (S, animals) is not distributed in the conclusion. So th question of the fallacy of illicit minor does not arise. The major ter (P, men) is distributed in the conclusion and also in the maj premise. So it is free from the fallacy of illicit major.

Therefore, AOO is a valid mood of Fig II. It is technically call Baroco.

5. **EA**–No P is M.	No parrots are black.
All S is M.	All crows are black.

Here, one premise is negative. So, the conclusion, if any, m be negative, i.e., E or O.

(a) E–No P is M.	No parrots are black–E.
A–All S is M.	All crows are black–A
∴ E–No S is P.	∴ No crows are parrots–

Here, the middle term (M, black) is distributed in the ma premise. So it is free from the fallacy of undistributed middle.

minor term (S, crows) is distributed in the conclusion and in the minor premise. So it is free from the fallacy of illicit minor. The major term (P, parrots) is distributed in the conclusion and in the major premise. So, it is free from the fallacy of illicit major.

Therefore, EAE is a valid mood of Fig II. It is technically called Cesare.

(b) E–No P is M.	No parrots are black–E.
A–All S is M.	All crows are black–A.
∴ O–Some S is not P.	∴ Some crows are not parrots –O.

Like (a), this is free from all fallacies. The minor term (S, crows) is distributed in the minor premise, and not distributed in the conclusion; but this is not fallacious.

Therefore, the mood EAO is valid in Fig.II. It is technically called Cesaro.

Cesare is the main mood and Cesaro is its weakened or subaltern mood.

6. EI—No P is M.	No parrots are black.
Some S is M.	Some birds are black.

Here one premise is negative and the other premise is particular. So the conclusion, if any, must be particular negative, *i.e*,O.

E–No P is M.	No parrots are black–E.
I–Some S is M.	Some birds are black–I.
∴ O–Some S is not P.	∴ Some birds are not parrots–O.

Here, the middle term (M, black) is distributed in the major premise. So it is free from the fallacy of undistributed middle. The minor term (S, birds) is not distributed in the conclusion. So, the question of the fallacy of illicit minor does not arise. The major term (P, parrots) is distributed in both the conclusion and the major premise. So, it is free from the fallacy of illicit major.

Therefore, EIO is a valid mood of Fig. II. It is technically called Festino.

7. IA–Some P is M.	Some dogs are black.
All S is M.	All crows are black.

Here, both the premises are affirmative and one premise is particular. So, the conclusion, if any, must by particular affirmative, i.e., I. But the middle term is not at all distributed. So, it commits the fallacy of undistributed middle. Therefore, IA is not valid in Fig. II.

8. OA– Some P is not M. Some birds are not black.
All S is M. All crows are black.

Here, one premise is particular and negative. So, the conclusion, if any, must be particular negative, i.e., O.

O–Some P is not M. Some birds are not black–O.
A–All S is M. All crows are black–A.
∴ O–Some S is not P. ∴ Some crows are not birds–O.

Here,, the middle term (M, black) is distributed in the major premise. So, it is free from the fallacy of undistributed middle. The minor term (S, crows) is not distributed in the conclusion. So, the question of the fallacy of illicit minor does not arise here. The major term (P, birds) is distributed in the conclusion and not distributed in the major premise. So, it commits the fallacy of illicit major.

Therefore, OA is not a valid mood in Fig. II.

From the above discussion, it is clear that in Fig. II, four main moods, *viz.*,

AEE—Camestres

EAE—Cesare

AOO—Baroco

EIO—Festino

and *two* weakened or subaltern moods, *viz.*,

AEO—Camestrop

EAO—Cesaro

are valid. All other moods of this figure are invalid.

Figure III

1. AA—All M is P. All men are biped.
All M is S. All men are animals.

Here, both the premises are affirmative. So, the conclusion, if any, must be affirmative, *i.e.*, A or I.

(a)	A—All M is P.	All men are biped.—A.
	A—All M is S.	All men are animals.—A.
∴	A—All S is P.	∴ All animals are biped.—A.

Here, the middle term (M, men) is distributed in both the premises. So it is free from the fallacy of undistributed middle. The minor term (S, animals) is distributed in the conclusion, but not distributed in the minor premise. So, it commits the fallacy of illicit minor. Therefore, AAA is not valid in Fig. III.

(b)	A—All M is P.	All men are biped.—A.
	A—All M is S.	All men are animals.—A.
∴	I—Some S is P.	∴ Some animals are biped.—I.

Like (a), it is free from the fallacy of undistributed middle. The minor term (S, animals) is not distributed in the conclusion. So, the question of the fallacy of illicit minor does not arise here. The major term (P, biped) is not distributed in the conclusion. So, the question of the fallacy of illicit major does not arise here.

Therefore, AAI is a valid mood of Fig. III. It is technically called Darapti.

2.	AE—All M is P.	All men are biped.
	No M is S.	No men are birds.

Here, one premise is negative. So the conclusion, if any, must be negative, i.e., E or O.

(a)	A—All M is P.	All men are biped.—A.
	E—No M is S.	No men are birds.—E.
∴	E—No S is P.	∴ No birds are biped.—E.

Here, the middle term (M, men) is distributed in both the premises. So it is free from the fallacy of undistributed middle. The minor term (S, birds) is distributed in the conclusion and also in the minor premise. So it is free from the fallacy of illicit minor. The major term (P, biped) is distributed in the conclusion but not distributed in the major premise. So, it commits the fallacy of illicit major.

Therefore, AEE is not valid in Fig. III.

(b) A—All M is P.	All men are biped.—A.
E—No M is S.	No men are birds.—E.
∴ O—Some S is not P.	∴ Some birds are not biped.—O.

Like (a), this also commits the fallacy of illicit major. Therefore, AEO is not valid in Fig. III. Thus, AE in Fig. III is invalid.

3. AI—All M is P.	All fishes are aquatic.
Some M is S.	Some fishes are big animals.

Here, both the premises are affirmative and one premise is particular. So, the conclusion, if any, must be particular affirmative, *i.e.*, I.

A—All M is P.	All fishes are aquatic.—A.
I—Some M is S.	Some fishes are big animals.—I..
∴ I—Some S is P.	∴ Some big animals are aquatic.—I.

Here, the middle term (M, fishes) is distributed in the major premise. So, it is free from the fallacy of undistributed middle. The minor term (S, big animals) is not distributed in the conclusion. So the question of the fallacy of illicit minor does not arise. The major term (P, aquatic) is not distributed in the conclusion. So, the question of the fallacy of illicit major does not arise.

Therefore, AII is a valid mood of Fig. III. It is technically called Datisi.

4. AO—All M is P.	All men are biped.
Some M is not S.	Some men are not students.

Here, one premise is particular and negative. So the conclusion, if any, must be particular negative, *i.e.*, O.

A—All M is P.	All men are biped.—A.
O—Some M is not S.	Some men are not students.—O.
∴ O—Some S is not P.	∴ Some students are not biped.—O.

Here, the middle term (M, men) is distributed in the major premise. So, it is free from the fallacy of undistributed middle. The minor term (S, students) is not distributed in the conclusion. So, the question of the fallacy of illicit minor does not arise. The major term (P, biped) is distributed in the conclusion, but not distributed in the major premise. So it commits the fallacy of illicit major.

Therefore, AO is not valid in Fig. III.

EA— No M is P. No birds are men.
All M is S. All birds are bipeds.

Here, one premise is negative. So, the conclusion, if any, must be negative, *i.e.*, E or O.

(a) E—No M is P. No birds are men.—E.
A—All M is S. All birds are bipeds.—A.
∴ E—No S is P. ∴ No bipeds are men.—E.

Here, the middle term (M, birds) is distributed in both the premises. So, it is free from the fallacy of undistributed middle. The minor term (S, bipeds) is distributed in the conclusion, but not distributed in the minor premise. So, it commits the fallacy of illicit minor. Therefore, EAE is not valid in Fig. III.

(b) E—No M is P. No birds are men.—E.
A—All M is S. All birds are bipeds.—A.
∴ O—Some S is not P. ∴ Some bipeds are not men.—O.

Like (a), it is free from the fallacy of undistributed middle. The minor term (S, bipeds) is not distributed in the conclusion. So, the question of the fallacy of illicit minor does not arise. The major term (P, men) is distributed in the conclusion and also in the major premise. So, it is free from the fallacy of illicit major.

Therefore, EAO is a valid mood of Fig. III. It is technically called Felapton.

6. EI—No M is P. No birds are men.
Some M is S. Some birds are songsters.

Here, one premise is negative and the other premise is particular. So, the conclusion, if any, must be particular negative, *i.e.*, O.

E—No M is P. No birds are men.—E.
I—Some M is S. Some birds are songsters.—I.
∴ O—Some S is not P. ∴ Some songsters are not men.—O.

Here, the middle term (M, birds) is distributed in the major premise. So, it is free from the fallacy of undistributed middle. The minor term (S, songsters) is not distributed in the conclusion. So, the question of illicit minor does not arise. The major term (P, men) is distributed in the conclusion and also in the major premise. So, it is free from the fallacy of illicit major.

Therefore, EIO is a valid mood of Fig. III. It is technically called Ferison.

7. IA—Some M is P.	Some men are wise.
All M is S.	All men are animals.

Here, both the premises are affirmative and one premise is particular. So the conclusion, if any, must be particular affirmative, *i.e.,* I.

I—Some M is P.	Some men are wise.—I.
A—All M is S.	All men are animals.—A.
∴ I—Some S is P.	∴ Some animals are wise.—I.

Here, the middle term (M, men) is distributed in the minor premise. So, it is free from the fallacy of undistributed middle. The minor term (S, animals) is not distributed in the conclusion. So, the question of the fallacy of illicit minor does not arise. The major term (P, wise) is not distributed in the conclusion. So, the question of the fallacy of illicit major does not arise. Therefore, IAI is a valid mood of Fig. III. It is technically called Disamis.

8. OA—Some M is not P.	Some men are not literate.
All M is S.	All men are rational beings.

Here, one premise is particular and negative. So, the conclusion, if any, must be particular negative, *i.e.,* O.

O—Some M is not P.	Some men are not literate.—O.
A—All M is S.	All men are rational beings.—A.
∴ O—Some S is not P.	∴ Some rational beings are not literate.—O.

Here, the middle term (M, men) is distributed in the minor premise. So, it is free from the fallacy of undistributed middle. The minor term (S, rational beings) is not distributed in the conclusion. So, the question of the fallacy of illicit minor does not arise. The major term (P, literate) is distributed in the conclusion and also in the major premise. So, it is free from the fallacy of illicit major.

Therefore, OAO is a valid mood of Fig. III. It is technically called Bocardo.

From the above discussion, it is clear that in Fig. III *six* moods, viz.,

AAI—Darapti — ଡାରାପ୍ଟି
AII—Datisi — ଡାଟିସି.
IAI—Disamis — Di'Sami's.
EAO—Felapton — ଫେଲାପ୍ଟନ
EIO—Ferison — ଫେରିସନ୍.
OAO—Bocardo — ବୋକାର୍ଡୋ

are valid. All other moods of this figure are invalid.

Figure IV

1. AA—All P is M.

AA—All P is M.	All students are men.
All M is S.	All men are animals.

Here, both the premises are affirmative. So, the conclusion, if any, must be affirmative, i.e., A or I.

(a) A—All P is M.	All students are men—A.
A—All M is S.	All men are animals—A.
∴ A—All S is P.	∴ All animals are students—A.

Here, the middle term (M, men) is distributed in the minor premise. So it is free from the fallacy of undistributed middle. The minor term (S, animals) is distributed in the conclusion, but not distributed in the minor premise. So, it commits the fallacy of illicit minor. Therefore, AAA is not valid in Fig. IV.

(b) A—All P is M.	All students are men—A.
A—All M is S.	All men are animals—A.
∴ I—Some S is P.	∴ Some animals are students—I.

Like (a) this is free from the fallacy of undistributed middle. The minor term (S, animals) is not distributed in the conclusion. So, the question of the fallacy of illicit minor does not arise. The major term (P, students) is not distributed in the conclusion. So, the question of the fallacy of illicit major does not arise. Therefore, AAI is a valid mood of Fig. IV. It is technically called Bramantip.

2. AE—All P is M.	All students are men.
No M is S.	No men are beasts.

Here, one premise is negative. So, the conclusion, if any, must be negative, *i.e.*, E or O.

(a) A—All P is M.
E—No M is S.
∴ E—No S is P.

All students are men—A.
No men are beasts—E.
∴ No beasts are students—E.

Here, the middle term (M, men) is distributed in the minor premise. So it is free from the fallacy of undistributed middle. The minor term (S, beasts) is distributed in the conclusion and also in the minor premise. So, it is free from the fallacy of illicit minor. The major term (P, students) is distributed in the conclusion and also in the major premise. So, it is free from the fallacy of illicit major. Therefore, AEE is a valid mood of Fig. IV. It is technically called Camenes.

(b) A—All P is M.
E—No M is S.
∴ O—Some S is not P.

All students are men—A.
No men are beasts—E.
∴ Some beasts are not students—O.

Like (a), it is free from all fallacies. The minor term (S, beasts) is distributed in the minor premise and not distributed in the conclusion, but this is not fallacious.

Therefore, the mood AEO is valid in Fig. IV. It is technically called Camenop.

Camenes is the main mood and Camenop is its weakened or subaltern mood.

3. AI— All P is M.
Some M is S.

All men are animals.
Some animals are beasts.

Here, both the premises are affirmative and one premise is particular. So, the conclusion, if any, must be particular affirmative, *i.e.*, I. But here the middle term (M, animals) is not at all distributed. So, it commits the fallacy of undistributed middle.

Therefore, AI is not valid in Fig. IV.

4. AO—All P is M.
Some M is not S.

All men are animals.
Some animals are not rational.

Here, one premise is particular and negative. So, the con- usion, if any, must be particular negative, *i.e.*, O. But the middle rm (M, animals) is not at all distributed here. So it commits the llacy of undistributed middle.

Therefore, AO is not valid in Fig. IV.

EA—No P is M.   No men are birds.
All M is S.   All birds are bipeds.

Here, one premise is negative. So, the conclusion, if any, must negative, *i.e.*, E or O.

(a) E—No P is M.   No men are birds—E.
A—All M is S.   All birds are bipeds—A.
∴ E—No S is P.   ∴ No bipeds are men—E.

Here the middle term (M, birds) is distributed in both the remises. So it is free from the fallacy of undistributed middle. The inor term (S, bipeds) is distributed in the conclusion, but not istributed in the minor premise. So it commits the fallacy of illicit inor. Therefore, EAE is not valid in Fig. IV.

(b) E—No P is M.   No men are birds—E.
A—All M is S.   All birds are biped—A.
∴ O—Some S is not P.   ∴ Some bipeds are not men—O.

Like (a), it is free from the fallacy of undistributed middle. The inor term (S, bipeds) is not distributed in the conclusion. So, the uestion of the fallacy of illicit minor does not arise. The major term P, men) is distributed in the conclusion and also in the major remise. So, it is free from the fallacy of illicit major. Therefore, AO is a valid mood of Fig. IV. It is technically called Fesapo.

EI—No P is M.   No men are birds.
Some M is S.   Some birds are songsters.

Here, one premise is negative and the other premise is par- cular. So, the conclusion, if any, must be particular negative, i.e.,O.

E—No P is M.   No men are birds—E.
I—Some M is S.   Some birds are songsters—I.
∴ O—Some S is not P.   ∴ Some songsters are not men—O.

The major term (P, bipeds) is distributed in the conclusion, but not distributed in the major premise. So, it commits the fallacy of illicit major. Therefore, OA is not valid in Fig. IV.

From the above discussion, it is clear that in Fig IV, *five* main moods, *viz.*,

AAI—Bamantip
AEE—Camenes
IAI—Dimaris
EAO—Fesapo
EIO—Fresison

and *one* weakened or subaltern mood, *viz.*,

AEO—Camenop

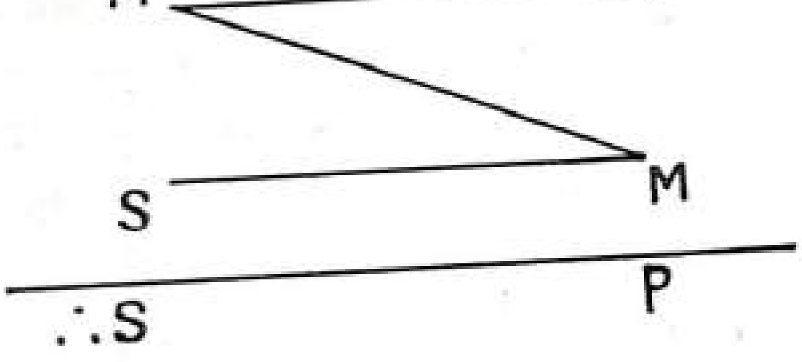
are valid. All other moods of this figure are invalid.

Special Syllogistic Rules and determination of valid moods by their application

Logicians have framed certain Special Syllogistic Rules for each of the four figures. They can be proved with the help of General Syllogistic Rules. We can determine the valid moods of the different figures with their help as well.

Figure I

The position of the terms in Fig. I is :



Special Syllogistic Rules :

1. The major premise must be universal.
2. The minor premise must be affirmative.

Proof :

1. If the major premise be not universal, it must be particula In that case, the middle term, which is the subject, cannot distributed in the major premise. In order to avoid the fallacy Undistributed Middle, it must be distributed in the minor premis where it is the predicate. Only negative propositions distribute the predicates. So, the minor premise must be negative. But in that ca the major premise must be affirmative and the conclusion must negative. This necessarily leads to the fallacy of Illicit Major, b cause the major premise, which is affirmative, does not distribute predicate, i.e., the major term; but the conclusion which is negativ distributes its predicate, i.e., the major term. Thus, we see that if th major premise in Fig. I be not universal, even if we avoid the othe fallacies; we cannot ultimately avoid the fallacy of Illicit Major. S the major premise of all valid moods in Fig. I must be universal.

2. If the minor premise be not affirmative, it must be negative In that case, the major premise must be affirmative and the con clusion must be negative. This, as stated above, leads to the fallac of Illicit Major. So, the minor premise of all valid moods in Fig. must be affirmative.

The sixteen possible moods of this figure are :

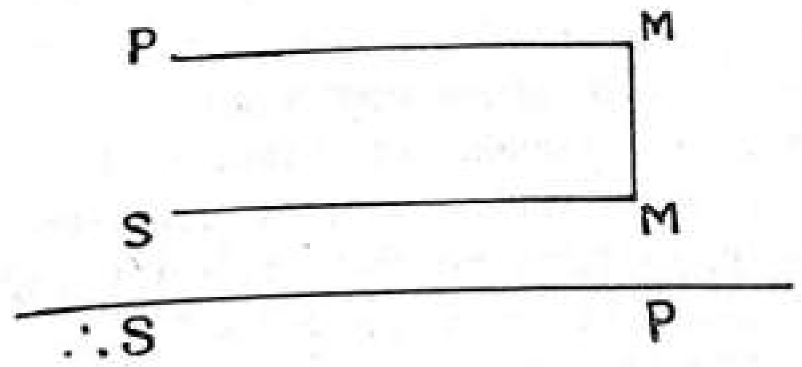
AA	EA	IA	OA
AE	EE	IE	OE
AI	EI	II	OI
AO	EO	IO	OO

Of these, eight moods, i.e., IA, IE, II, IO, OA, OE, OI and OO are invalid, because they violate Rule 1; four moods, i.e., AE, AO, EE and EO are invalid, because they violate Rule.2

The remaining four moods, i.e., AA, EA, AI and EI are valid in Fig. I. With their legitimate conclusions, as we already know, they are respectively called Barbara, Celarent, Darii and Ferio. From AA and EA, we get also the two subaltern moods, Barbari and Celaront.

Figure II

The position of the terms in Fig. II is :



Special Syllogistic Rules :

1. The major premise must be universal.
2. One of the two premises must be negative.

Proof :

1. If the major premise be not universal, it must be particular. Then the major term, which is the subject of this premise is not distributed and it cannot be distributed in the conclusion. But since it is the predicate in the conclusion and only affirmative propositions do not distribute their predicates, the conclusion must be affirmative. This necessitates that both the premises must be affirmative and their predicates are not distributed. So this necessarily leads to the fallacy of Undistributed Middle. Thus, we see that if the major premise in Fig. II be not universal, even if we avoid the other fallacies, we cannot ultimately avoid the fallacy of Undistributed

Middle. So, the major premise of all valid moods of Fig. II must be universal.

2. If one of the two premises be not negative, then either both of them are negative or both of them are affirmative. In the former case, no conclusion follows. In the latter case, we commit the fallacy of Undistributed Middle, since affirmative propositions do not distribute their predicates. So, one of the two premises of all valid moods of Fig II must be negative.

The sixteen possible moods of this figure are :

AA
AE
AI
AO

EA
EE
EI
EO

IA
IE
II
IO

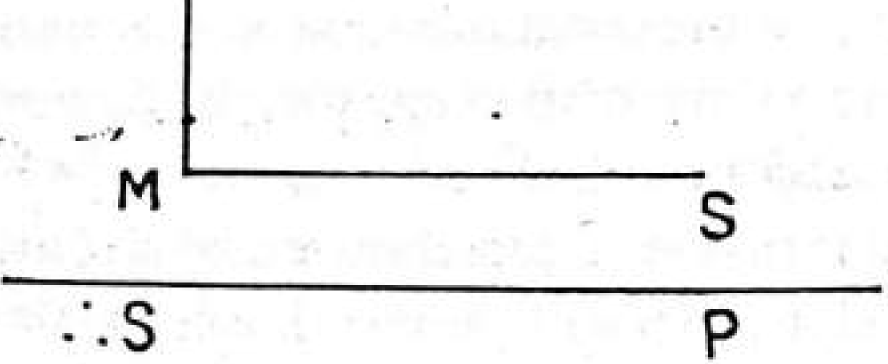
OA
OE
OI
OO

Of these, eight moods, i.e., IA, IE, II, IO, OA, OE, OI and OO are invalid, because they violate Rule 1; four moods, i.e., AA, AI, EE and EO are invalid, because they violate Rule 2.

The remaining four moods, i.e., AE, EA, AO and EI are valid in Fig. II. With their legitimate conclusions, as we already know, they are respectively called Camestres, Cesare, Baroco and Festino. From AE and EA we get also the two subaltern moods, Camestrop and Cesaro.

Figure III

The position of the terms in Fig.III is :



Special Syllogistic Rules :

1. The minor premise must be affirmative.
2. At least one premise must be universal.
3. The conclusion must be particular.

proof :

1. If the minor premise be not affirmative, it must be negative. In that case, the major premise is affirmative and the conclusion is negative. This leads to the fallacy of Illicit Major, because the affirmative major premise does not distribute its predicate, the major term; but the negative conclusion distributes its predicate, *i.e.*, the major term. We cannot avoid this fallacy if the minor premise be negative. So, the minor premise of all valid moods of Fig. III must be universal.

2. If at least one premise be not universal, then both the premises must be particular. They do not distribute their subjects and so the middle term cannot be distributed at all. Thus, it necessarily leads to the fallacy of Undistributed Middle, if none of the premises be universal. So at least one of the premises of all valid moods of Fig. III must be universal. It may be seen that this special syllogistic rule of Fig. III is the same as the General Syllogistic Rule that 'from two particular premises no conclusion follows.'

3. If the conclusion be not particular, it must be universal. In that case, the minor term is distributed in the conclusion and it should be distributed in the minor premise to avoid the fallacy of Illicit Minor. It is at the predicate's place in the minor premise. So, the minor premise must be negative. This necessitates that the major premise be affirmative and the conclusion be negative. But in that case, the major term is distributed in the conclusion, without being distributed in the major premise leading to the fallacy of Illicit Major. Thus we see that if the conclusion in Fig. III be universal, even if we avoid the other fallacies, we ultimately commit the fallacy

of Illicit Major. So, the conclusion of all valid moods of Fig. III must be particular.

The sixteen possible moods of this Figure are :

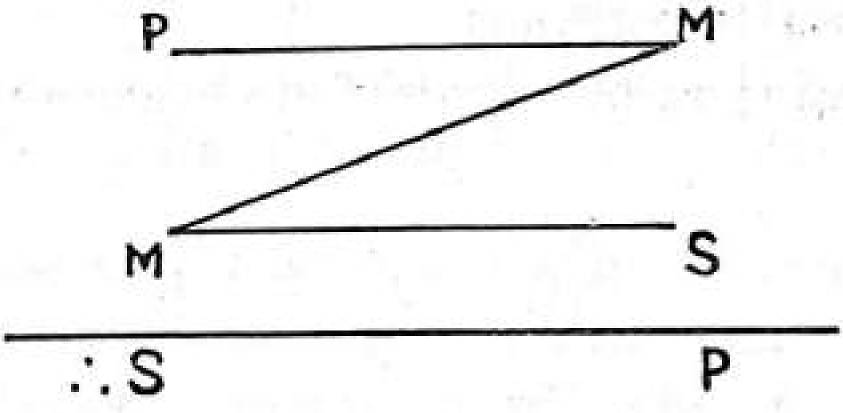
AA	EA	IA	OA
AE	EE	IE	OE
AI	EI	II	OI
AO	EO	IO	OO

Of these, eight moods, i.e., AE, EE, IE, OE, AO, EO, IO, and OO are invalid , because they violate Rule 1; two moods, i.e., II and OI are invalid, because they violate Rule 2.

The remaining six moods, i.e., AA, AI, IA, EA, EI and OA are valid; but according to Rule 3, they lead only to particular conclusions. So they are AAI, AII, IAI, EAO, EIO and OAO. These as we already know, are respectively called Darapti, Datisi, Disamis Felapton, Ferison and Bocardo.

Figure IV

The position of the terms in Fig.IV is :



Special Syllogistic Rules :

1. If the major premise is affirmative, the minor premise mu be universal.

2. If any premise is negative, the major premise must be unive sal.

3. Both the premises cannot be negative.

4. If the minor premise is affirmative, the conclusion is particular.

Proof:

1. If the major premise is affirmative, it does not distribute its predicate, i.e., the Middle term. To avoid the fallacy of Undistributed Middle, the middle term must be distributed in the minor premise, where it is the subject. So, in this case, the minor premise must be universal.

2. If any premise is negative, the conclusion must be negative and the major term is distributed in the conclusion. To avoid the fallacy of illicit Major, the major term must be distributed in the major premise, where it is the subject. So, in this case, the major premise must be universal.

3. If both the premises are negative, no conclusion follows. This is one of the general syllogistic rules. It is stated as a special syllogistic rule of Fig. IV in order to make the Special Syllogistic Rules self-sufficient to determine the valid moods of this figure (For proof see General Syllogistic Rules).

4. If the minor premise is affirmative, the minor term is not distributed in the minor premise. Consequently, it cannot be distributed in the conclusion, where it is the subject. So in this case, the conclusion must be particular.

The sixteen possible moods of this figure are :

AA	EA	IA	OA
AE	EE	IE	OE
AI	EI	II	OI
AO	EO	IO	OO

Of these, four moods, i.e., AI, AO, II and IO are invalid, because they violate Rule 1; three moods, i.e., IE, OA and OI are invalid, because they violate Rule 2; four moods i.e., EE, EO, OE and OO are invalid, because they violate Rule 3.

The remaining five moods, i.e., AA, AE, EA, EI and IA are valid. According to Rule 4, the conclusion of AA is I and the conclusion of EA is O. So the valid moods of Fig. IV are AAI, AEE, EAO, EIO and IAI. These, as we already know, are respectively called Bramantip, Camenes, Fesapo, Fresison and Dimaris. From Camenes, we get also the subaltern mood Camenop.

ARISTOTLE'S DICTUM

In order to test the validity of syllogisms, Aristotle had framed a rule. It is called Aristotle's *Dictum de omni et nullo*, which literally means statement concerning all and none. The dictum may be stated in the words of Whately thus :

"Whatever is predicated (i.e., affirmed or denied) universally of any class of things, may be predicated in like manner, (viz., affirmed or denied) of anything comprehended in that class."

Let us try to understand the significance of the dictum with the help of the following examples :

(1) All men are biped.
Ram is a man.
∴ Ram is biped.

(2) No men are quadruped.
Some animals are men.
∴ Some animals are not quadruped.

(3) All the children of this class are capable of pushing away a truck.
Ram is a child of this class.
∴ Ram is capable of pushing away a truck.

In example 1, the attribute 'bipedness' has been affirmed of the class 'man' universally, in the first premise. In the second premise, Ram is said to be comprehended in the class 'man'. So in the conclusion bipedness has been affirmed of Ram. This is in accordance with the dictum.

In example 2, the attribute 'quadrupedness' has been denied of the class 'man' universally, in the premise. In the second premise, some animals are said to be comprehended in the class 'man'. So, in the conclusion, quadrupedness has been denied of some animals. This is also in accordance with the dictum.

Example 3 appears to be similar to example 1. But the conclusion is obviously wrong. Its difference from Example 1 is that while in Example 1, the class 'man' is used distributively,in Example 3, the class 'children of this class' has been used collectively. So it is clear that for the application of the dictum, the class should be used distributively. Example 3 is not in accordance with the dictum.

It may be seen that for the application of the dictum the following conditions must be fulfilled :

1. An attribute be predicated of an entire class distributively. Naturally, it must be a universal proposition.

2. An individual or a subclass be noticed to have been contained in the class. Naturally, this must be an affirmative proposition.

From these two propositions, the dictum asserts that the attribute can be validly predicated of the individual or the subclass in the same manner as predicated in the first proposition.

From the conclusion, it is clear that the 'individual or the subclass' is the minor term, the 'attribute' is the major term and the 'class' is the middle term. Using the usual symbols S, P and M for the minor, major and middle terms respectively, premises of all valid syllogisms in accordance with the dictum can be symbolically expressed thus :

All (or No) M is P.

All (or Some) S is M.

From this it may be noticed that the dictum requires that the valid syllogisms should be in Fig. I; the major premise must be universal and the minor premise must be affirmative. These are the special syllogistic rules of Fig. I. Aristotle called the First figure the perfect figure and valid moods of this figure, i.e., Barbara, Celarent, Darii and Ferio, the perfect moods, because they are perfectly in accordance with the dictum.

The other figures and the other moods are called by him imperfect. They need to be transformed to moods of the First figure so that we can know them as valid or invalid. If an imperfect mood of the imperfect figure is capable of being transformed into either Barbara or Celarent or Darii or Ferio, it is valid. If it is not capable of being transformed thus, it is invalid. This process of transformation is called Reduction. So, for the Aristotelian method of testing the validity of moods, Reduction is a necessary complementary process.

Reduction

Reduction in the Aristotelian sense may be defined as "the process of proving the validity of the moods of the imperfect figures with the help of the perfect moods." It may be either direct or indirect. Direct Reduction is the process of directly transforming an imperfect mood to a perfect mood. The perfect moods i.e., Barbara, Celarent, Darii and Ferio are recognisedly valid, since they are strictly in accordance with the Dictum. So, any mood of the Second, Third and Fourth figure,which is shown to be equivalent to one of them,is also recognised as valid. This is done by the transposition of the premises and the application of immediate inference. Indirect Reduction is the process of showing with the help of the perfect moods that some moods of the Second, Third and Fourth figure are such that if the premises be taken as true, the conclusion cannot be false. So, these moods are recognised as valid.

Direct Reduction

The Schoolmen of the 13th century have named the valid moods of the different figures in such a way that the names themselves contain detailed instructions as to how the imperfect moods can be directly reduced to the moods of the perfect figures.

The four perfect moods of the perfect figure are Barbara, Celarent, Darii and Ferio. These begin with the first four consonants of the Alphabet. Each name has three vowels which indicate the quality and quantity of the propositions in the mood. The first vowel stands for the major premise, the second for the minor premise and the third for the conclusion.

The initial letter of a mood of the imperfect figure indicates that the mood is to be reduced to a mood of the first figure having the same initial letter. The inventor of these names did not make use of obversion and Baroco of Fig. II and Bocardo of Fig. III could not be reduced directly. So the letter B in these two cases only means that these moods are to be reduced indirectly with the help of the perfect mood Barbara. Other logicians have shown that even Baroco and Bocardo can be reduced directly to Ferio and Darii, if we make use of obversion. So these moods are renamed as Faksoko and Doksamosk respectively.

The S in the name indicates simple conversion of the proposition indicated by the preceding vowel. Similarly, P and K indicate partial conversion and obversion respectively; KS indicates first obversion and then conversion; and SK indicates first conversion and then obversion. If these letters occur after the third vowel, then they indicate the corresponding processes not of the conclusion of the imperfect mood but of the conclusion of the perfect mood.

The M in the name indicates transposition of premise, i.e., the major premise of the imperfect mood becomes the minor premise of the perfect mood and *vice versa.*

xamples of Direct Reduction

Cesare (Fig. II)		**Celarent (Fig I)**
E—No P is M	———— (by s) ————→	E—No M is P
A—All S is M	————————————→	A—All S is M
E—No S is P		∴ *E—No S is P*

Darapti (Fig. III)		**Darii (Fig. I)**
A—All M is P	————————————→	A—All M is P
A—All M is S	———— (by p) ————→	I—Some S is M
I—Some S is P		∴ I—*Some S is P*

3. **Fesapo (Fig. IV)** — **Ferio (Fig. I)**

E—No P is M ——— (by s) ——— E—No M is P
A—All M is S ——— (by p) ——— I—Some S is M
∴ *O—Some S is not P* ∴ *O—Some S is not P*

4. **Bramantip (Fig. IV)** — **Barbara (Fig. I)**

A— All P is M ——— X ——— A—All M is S
A—All M is S ——— ——— A—All P is M.
∴ *I—Some S is P* (by m) ∴ A—All P is S
(by p) ∴ *I—Some S is P*

5. **Dimaris (Fig IV)** — **Darii (Fig.I)**

I—Some P is M ——— X ——— A—All M is S
A—All M is S ——— ——— I—Some P is M
∴ *I—Some S is P* (by m) ∴ I— Some P is P
(by s) ∴ *I— Some S is P*

6. **Disamis (Fig. III)** — **Darii (Fig. I)**

I—Some M is P
(by s) Some P is M ——— X ——— A—All M is S
A—All M is S ——— ——— I—Some P is M
∴ *I—Some S is P* (by m) ∴ I—Some P is S
(by s) ∴ *I—Some S is P*

7. **Baroco—Faksoko (Fig II)** — Ferio (Fig.I)

A—All P is M
(by K) E— No P is not-M
(by s) E—No not-M is P ——— E—No not-M is P
O—Some S is not M ——— (by k) ——— I—Some S is not-M
∴ *O—Some S is not P* ∴ *O—Some S is not P*

8. **Bocardo—Doksamosk(Fig. III)** — **Darii (Fig I)**

O—Some M is not-P
(by k) I—Some M is not-P
(by s) I—Some not-P is M ——— X ——— A—All M is S
A—All M is S . . . . ——— ——— I—Some not-P is M
∴ *O—Some S is not P* (by m) ∴ I—Some not—P is S
(by s) ∴ I—Some S is not-P
(by k) ∴ *O—Some S is not-P*

9. **Camestres (Fig II.)** **Celarent (Fig I)**
A—All men are bepeds —— X —— E—No bipeds are beasts
E—Nobeasts are bepeds —— —— A—All men are bipeds
(by s) E—No bipeds are beasts (by m) ∴ E—No men are beasts
∴ E–No beasts are men (by s) ∴ *E—No beasts are men*

10. **Datisi (Fig. III)** **Darii (Fig. I)**
A—All pets are domestic —— A—Sll pets are domestic
I—Some pets are birds —— (by s) —— I—Some birds are pets
∴ I–Some birds are domestic ∴ *I—Some birds are dometic*

Indirect Reduction

Formerly, only Baroco (Fig. II) and Bocardo (Fig. III) were being reduced indirectly, since they could not be reduced directly without applying the process of Obversion. Later logicians have shown that the other moods can also be similarly reduced and can be shown to be valid with the help of the perfect moods.

By this method it is shown that if the premises of the valid moods of the imperfect figures be taken as true, it becomes absurd or impossible to take their conclusions as false. So this process is also called *Reductio ad absurdum or Reductio per impossible.*

Examples of Indirect Reduction

1. Baroco (Fig. II)
A—All P is M.
O—Some S is not M.
∴ O—Some S is not P.

By taking the premises of a mood to be true, if we find that the conclusion cannot be fase, then the mood is valid. Let us take the premises of Baroco to be true and examine whether the conclusion can be false. If the conclusion be false, then its contradictory, i.e., A– All S is P must be true.

Let us construct a perfect mood by taking this A—proposition as one premise and one of the original premises as another premise thus :

9. **Camestres (Fig II.)**		**Celarent (Fig I)**
A—All men are bepeds	—— X ——→	E—No bipeds are beasts
E—Nobeasts are bepeds	←—— (by m) ——→	A—All men are bipeds
(by s) E—No bipeds are beasts	∴	E—No men are beasts
∴ E–No beasts are men	(by s) ∴	*E—No beasts are men*
10. **Datisi (Fig. III)**		**Darii (Fig. I)**
A—All pets are domestic	——————→	A—Sll pets are domestic
I—Some pets are birds	—— (by s) ——→	I—Some birds are pets
∴ I–Some birds are domestic	∴	*I—Some birds are dometic*

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Examples of Indirect Reduction

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O—Some S is not M.
∴ O—Some S is not P.

By taking the premises of a mood to be true, if we find that the conclusion cannot be fase, then the mood is valid. Let us take the premises of Baroco to be true and examine whether the conclusion can be false. If the conclusion be false, then its contradictory, i.e., A– All S is P must be true.

Let us construct a perfect mood by taking this A—proposition as one premise and one of the original premises as another premise thus :

A—All P is M.
A—All S is P.
∴ A—All S is M.

This is Barbara of Fig. I in which P is th emiddle term. Now the conclusion of Barbara is the contradictory of a permise of Baroco, i.e. O—Some S is not M, which was teken as true. So the conclusion must be false. The falstiy of this conclusion is neither becasue of the argument, which is a perfect mood nor because of the major premise, i.e., A—All P is M, which has been taken as true . So the minor premise, i.e., A—All S is P must be false. From this it follows that its contradictory O— Some S is not P, i.e., the original conclusion must be true.

Thus we see that if the premises of Baroco be taken as true, its conclusion cannot be false. So Baroco is a valid mood.

2. Bocardo (Fig. III)
O—Some M is not P.
A—All M is S.
∴ O— Some S is not P.

By taking the premises of Bocardo as true, if we prove that the conclusion cannot but be true, then Bocardo is a valid mood. Let us take the premises of Bocardo to be true and see whether the conclusion can be false. If the conclusion O—Some S is not P be false, then its contradictoryA—All S is P must be true.

Let us construct a perfect mood with this A— All S is P as one premise and a premise of Bocardo A—All M is S as another premise thus :

A—All S is P.
A–All M is S.
∴ A—All M is P.

This is Barbara in Fig. I in which S is the middle term. Its conclusion A—All M is P is contradictory of the premise of Bocardo O—Some M is not P, which was assumed as true. So the conclusion of Barbara must be false. The falsity of this conclusion is not due to the invalidity of the argument, since the argument is in the perfect mood, Barbara. It is also not due to the falsity of the premise A—All M is S, since it is taken as true. So, the other premise, i.e., A—All S is P must be false. Therefore, its contradictory, O—Some S is not P must be true. This is the conclusion of Bocardo.

Thus we prove that if the premises of Bocardo be taken as true its conclusion must be true. So Bocardo is a valid mood.

3. Bramantip (Fig. IV)

A—All P is M.
A—All M is S.
∴ I—Some S is P.

Let us take the premises of Bramantip as true and see whether the conclusion can be false. If the conclusion I—Some S is P be false, its contradictory E—No S is P must be true. With this as a premise and one of the premises of Bramantip as another premise, let us construct the perfect mood Celarent in Fig. I thus and convert its conclusion.

E—No S is P.
A—All M is S.
∴ E—No M is P.
By conversion ∴ E—No P is M.

E—No P is M is the contrary of A—All P is M. So both cannot be true. But A—All P is M is assumed as true. So E—No P is M must be false. This is the converse of E—No M is P. Conversion being a valid inferential process, the falsity of the converse is not due to the process of inference, so the convertend E—No P is M, i.e., the conclusion of Celarent must be false. The falsity of the conclusion of Celarent is neither due to the process of reasoning, which is a perfect mood nor due to the falsity of the premise A—All M is S, which is taken as true. So the other premise E—No S is P must be false. From this it follows that its contradictory I—Some S is P, i.e., the conclusion of Bramantip must be true.

Thus it is proved that if the premises of Bramantip be taken as true, the conclusion must be true. So Bramantip is a valid mood.

4. Camestres (Fig. II)

A—All men are bipeds.
E—No beasts are bipeds.
∴ E—No beasts are men.

Let us take the premises of Camestres to be true and see whether the conclusion can be false. If the conclusion E—No beasts are men be false, then its contradictory I—Some beasts are men must be true. With this as a premise and one of the original premises as another premise, let us construct a perfect mood thus :

A—All men are bipeds.
I—Some beasts are men.
∴ I—Some beasts are bipeds.

This is Darii, 'men' being its middle term. The conclusion I—Some beasts are bipeds is the contradictory of the premise E—No beasts are bipeds, which is taken as true. So it must be false. The falsity is neither due to the process of reasoning, which is the perfect mood Darii, nor due to the major premise of Darii, i.e., A—All men are bipeds which is taken as true. So the minor premise of Darii, i.e., I—Some beasts are men must be false. From this it follows that its contradictory, E—No beasts are men, i.e., the original conclusion must be true.

Thus we prove that if the premises of Camestres be taken as true, its conclusion must be true. So Camestres is a valid mood.

5. Datisi (Fig III)

A—All pets are domestic.
I—Some pets are birds.
∴ I—Some birds are domestic.

Let us take the premises of Datisi to be true and see whether the conclusion can be false. If the conclusion I—Some birds are domestic be false, its contradictory E—No birds are domestic must be true. With this as a premise and one of the original premises as another premise, let us construct a perfect mood thus :

E—No birds are domestic.
E—Some pets are birds.
∴ O—Some pets are not domestic.

This is Ferio, 'birds' being its middle term. The conclusion of Ferio O—Some pets are not domestic is the contradictory of the major premise of Datisi, i.e., A—All pets are domestic, which was assumed as true. So the conclusion is false. Its falsity is neither due to the process of reasoning which is a perfect mood nor due to the minor premise of Ferio, which is same as the original premise assumed to be true. So the major premise of Ferio, i.e., E—No birds are domestic, must be false. It follows from this that its contradictory I—Some birds are domestic, i.e., the original conclusion must be true.

Thus it is proved that if the premises of Datisi be taken as true, its conclusion cannot be false. So Datisi is a valid mood.

Value of Reduction

Aristotelian Logicians attached great importance on Reduction, since the dictum *de omni et nullo* guaranteed the validity of only Barbara, Celarent, Darii and Ferio of Fig. I and it was Reduction which shew that the other valid moods of other figures were their equivalent arguments.

We have seen that there are other methods of testing the moods and determining their validity. So some logicians have even criticised Reduction as an unnecessary and unnatural process. But these days, 'Reduction' is used in a broad sense and it serves an important purpose. It no longer means transformation of the moods of the Second, Third and Fourth figures to only the moods of the First figure. It can be shown now that the moods of the same figure are also mutually transformable. So Reduction in the broad sense means transformation of one mood to a different mood irrespective of thier figures.

Since we can have simple conversion of E and I propositions, all moods having E and I as premises are equivalents and give the same conclusion O, irrespective of their figures.

Ferio (Fig. I)		Festino (Fig. II)		Ferison (Fig. III)		Fresison (Fig. IV)
MeP	≡	PeM	≡	MeP	≡	PeM
SiM	≡	SiM	≡	MiS	≡	MiS
∴ SoP	≡	∴ SoP	≡	∴ SoP	≡	∴ SoP

Similarly,

Celarent (Fig. I) ≡ Cesare (Fig. II) ≡ Camestres (Fig. II)
≡ Camenes (Fig. IV)

Darii (Fig. I) ≡ Datisi (Fig. III) ≡ Disamis (Fig. III)
≡ Dimaris (Fig. IV)

Since by obversion we can get for a proposition an equivalent proposition with the opposite quality, we may have other equivalent moods in different figures. Thus, Barbara may be shown to be equivalent to Celarent, Cesare etc., and Darii may be shown to be equivalent to Ferio, Festino etc.

Barbara		Celarent		Cesare
MaP	≡	Me$\bar{P}$	≡	$\bar{P}$eM
SaM	≡	SaM	≡	SaM
∴ SaP	≡	∴ Se$\bar{P}$	≡	∴ Se$\bar{P}$

Similarly, all moods having I or O as conclusion can be shown to be equivalent. So the purpose of Reduction these days is to show that though the moods are large in number and appear to be formally different, many of them are virtually the same and they illustrate only two principles of reasoning, one giving a universal and the other giving a particular conclusion.

Fundamental, strengthened and weakened moods

A mood is said to be fundamental, if no term is unnecessarily distributed in its premises. In a fundamental mood the middle term is distributed *only* once and any term that is distributed in the premise is also distributed in the conclusion.

Out of the 24 valid moods the following fifteen moods are fundamental.

Fig. I—Barbara, Celarent, Darii, Ferio.

Fig. II—Cesare, Camestres, Baroco, Festino.

Fig. III— Datisi, Disamis, Bocardo, Ferison.

Fig. IV— Camenes, Dimaris, Fresison.

It may be seen that these moods are the only moods which are valid from the standpoint of existential import. In each case of a conclusion having existential import (particular proposition) there is a premise having existential import.

A mood is said to be strengthened, if one of its premises is unnecessarily stronger than what is required to prove the conclusion. In the case of a strengthened mood even if a universal premise be substituted by its corresponding particular proposition, still the same conclusion follows.

Out of the 24 valid moods, the following eight moods are strengthened.

Fig. I—Barbari, Celaront.

Fig. II—Cesaro, Camestrop.

Fig. III—Darapti, Felapton.

Fig. IV—Bramantip, Fesapo.

A mood is said to be weakened, if its conclusion is weaker than what is justified by its premises. Though the premises can validate a universal conclusion, in a weakened mood the corresponding particular proposition, is drawn as the conclusion.

Out of the 24 valid moods, the following five moods are weakened.

Fig. I—Barbari, Celaront.

Fig. II—Cesaro, Camestrop.

Fig. IV—Camenop.

In Fig. III there is no weakened mood, since the conclusions re always particular. The weakened moods are also called subaltern moods, because the conclusion here is the subaltern of the universal proposition that can be drawn from the premises.

It may be noted that all weakened moods except Camenop are also strengthened. In these cases, the conclusion could be universal, but we take the corresponding particular proposition as the conclusion. Thus the minor term is not distributed in the conclusion though it is distributed in the premise. In each of the cases of Barbari, Celaront, Cesaro and Camestrop, we may substitute the corresponding particular propositions for the universal minor premises and get respectively the valid moods Darii, Ferio, Festino and Baroco. So Barbari, Celaront, Cesaro and Camestrop are weakened as well as strengthened moods. They are weakened if we take into consideration the conclusion and they are strengthened if we take into consideration the premises. Camenop,however, is not a strengthened mood, because none of the universal premises can be substituted by its corresponding particular proposition, giving us a valid conclusion. In Camenop, if the premise A becomes I, we commit the fallacy of illicit major and if the premise E becomes O, we commit the fallacy of undistributed middle. So Camenop is a weakened mood, but not a strengthened mood.

CHARACTERISTICS AND USES OF THE DIFFERENT FIGURES

Figure I

1. The terms of propositions are used either to indicate individuals or to indicate characteristics. Generally, the subject is used denotatively, that is, to indicate individuals, and the predicate is used connotatively, that is, to indicate characteristics. The natural order of a reasoning is that the term which is used as subject of a premise is also used as subject of the conclusion and the term which is used as predicate of a premise is also used as predicate of the conclusion. Otherwise, there is the possibility of passing from the denotative use of a term to its connotative use and *vice versa*. It is the first figure

alone where this order is retained, because the subject of the minor premise is the subject of the conclusion and the predicate of the major premise is the predicate of the conclusion. This figure is, therefore, called the natural form of syllogistic reasoning. Further, Aristotle's *dictum de omni et nullo* directly applies to only this figure. So Aristotle's naming it as the perfect figure is justifiable.

2. This is the only figure which can establish all forms of propositions, viz., A, E, I and O. So, it serves all purposes. From this standpoint also, it deserves to be called the perfect figure.

3. Knowledge of universal affirmative or A propositions is very valuable in life and in sciences. It is this figure alone which can deductively establish such propositions. So, naturally logicians attach very great importance to this figure.

Figure II

1. In this figure the natural order in the use of terms is only partially retained. The major term is subject in the major premise, but predicate in the conclusion. So there is the possibility of passing from its denotative use to its connotative use.

2. This figure proves only negative conclusions. Lambert, therefore, points out that this figure is suitable for proving the distinctions between things.

No men are winged creatures.
All birds are winged creatures.
∴ No birds are men.
All students are literate.
Some youngmen are not literate.
∴ Some youngmen are not students.

Figure III

1. In this figure, the natural order in the use of terms is only partially retained. The minor term is predicate in the minor premise, but subject in the conclusion. So there is the possibility of passing from its connotative use to its denotative use.

2. This figure proves only particular conclusions. Lambert, therefore, points out that this figure is suitable to prove exceptions, e.g.,

Mercury is not solid,
Mercury is a metal.
∴ Some metal is not solid.
Some men are immoral,
All men are rational.
∴ Some rational beings are immoral.

3. Whenever the middle term is singular, the argument is in Figure III, e.g.,

The Himalayas is in India.
The Himalayas is the highest mountain range.
∴ The highest mountain range is in India.

Figure IV

1. In this figure, there is a complete reversion of the natural order in the use of terms. The term used as subject in the premise is used as predicate in the conclusion and *vice versa*. So there is a possibility of passing from the denotative use of a term to its connotative use and *vice versa*. Aristotle, therefore, ignores this figure and Bowen condemns it as a perverted figure. We generally argue in Fig. I and if necessary, convert the conclusion in order to get what is established in Fig. IV.

2. Lambert, however, observes that this figure is suitable to "the discovery of exclusion of the different species of a genus", e.g.,

All lions are quadruped.
All quadrupeds are beasts.
∴ Some beasts are lions.
No circles are rectilinear.
All rectilinear figures are geometrical figures.
∴ Some geometrical figures are not circles.

It may be remarked that even such relations are more satisfactorily proved by the first rather than the fourth figure.

Proof of Some Syllogistic Deductions

1. If the conclusion be A, the argument must be in Fig. I.

Proof : If the conclusion is A, both the premises must be A. The minor term is distributed in the conclusion and it must be distributed in the minor premise. The minor premise being A distributes only the subject term. So the minor term must be the subject here and the middle term the predicate. Thus the middle term is undistributed. But the middle term must be distributed at least once in the premises. So it must be the subject of the Major premise, which being A distributes only its subject. So it is evident that if the conclusion is A, the middle term is subject in the major premise and predicate in the minor premise. Such a position of the Middle term is possible only in Fig. I. So if the conclusion is A, the argument must be in Fig. I.

2. O proposition cannot be a premise in Fig. I.

Proof : If one premise be O, the other premise must be A, and the conclusion must be O. So, the mood is either OAO or AOO. In Fig. I., both these moods are invalid.

O—Some M is not P.
A—All S is M.
∴ O—Some S is not P.

Here, the middle term is not at all distributed. So, it commits the fallacy of Undistributed Middle.

A—All M is P.
O—Some S is not M.
∴ O—Some S is not P.

Here, the major term is distributed in the conclusion, but not istributed in the major premise. So, it commits the fallacy of Illicit ajor. Therefore, O cannot be a premise in Fig. I

The middle term cannot be distributed twice in Fig. I and in Fig. II.

Proof : The position of the terms in Fig. I is :

M P
S M
∴ S P

If the middle term is distributed twice, then the major premise is universal and the minor premise is negative. The minor premise being negative, the conclusion must be negative and the major premise must be affirmative. In that case, the major term is distributed in the conclusion, but not distributed in the major premise leading to the fallacy of Illicit Major. So, the middle term cannot be distributed twice in Fig. I.

The position of the terms in Fig. II is :

P M

S M

∴ S P

If the middle term is distributed twice, then both the premises are negative and no conclusion follows. So, the middle term cannot be distributed twice in Fig. II.

4. The conclusion in Fig. II is always negative.

Proof : The premises are either both affirmative or both negative or one negative and the other affirmative. In Fig. II, if both the premises are affirmative, the middle term is not at all distributed, since affirmative propositions do not distribute their predicates. Thus, in this case there arises the fallacy of Undistributed Middle. If both the premises are negative, no conclusion follows. So, the only alternative left is that one premise must be negative and the other affirmative. This necessarily leads to a negative conclusion. So, in Fig. II, the conclusion is always negative.

5. O proposition cannot be a premise in Fig.IV.

Proof : If one premise be O, the other premise is A and the conclusion is O. So, the mood is either OAO or AOO. Let us examine each of these moods in Fig. IV.

O—Some P is not M.
A—All M is S.
∴ O—Some S is not P.

Here, we commit the fallacy of Illicit Major, because the major term is distributed in the conclusion, but not distributed in the major premise.

A—All P is M.
O—Some M is not S.
∴ O—Some S is not P.

Here, we commit the fallacy of Undistributed Middle, because the middle term is not at all distributed.

So, O proposition cannot be a premise in Fig. IV.

6. *If the conclusion is universal, the middle term can be distributed only once.*

Proof : If the conclusion is universal, it is either A or E.

In the case of A, both the premises are A and only two terms are distributed in the premises. One of them must be the minor term, otherwise there arises the fallacy of Illicit Minor. So only one term is left distributed for the middle term.

In the case of E, the premises are either EA or AE and three terms are distributed in the premises. Two of these must be the minor and the major terms to avoid the fallacies of the Illicit Process. So only one term is left distributed for the middle term.

Therefore, if the conclusion is universal, the middle term can be distributed only once.

7. *If the major term is predicate in the major premise, the minor premise must be affirmative.*

Proof : The major term in the major premise is either distributed or undistributed.

If it is distributed, then the major premise must be negative. So, n this case, the minor premise must be affirmative.

If it is undistributed, then it can not be distributed in the onclusion and the conslusion must be affirmative. If the conclusion s affirmative, then both the premises must be affirmative.

Therefore, if the major term is predicate in the major premise, the minor premise must be affirmative.

8. *If the middle term is distributed twice, the conclusion must be particular.*

Proof : If the middle term is distributed twice, no premise can be I, since I distributes nothing. So, the premises are AA, AE, AO, EE, EO and OO in any order. Of these, the combinations EE, EO and OO give no conclusion, since both the premises are negative. The combination AO gives rise to the fallacy of Illicit Major. Here, only two terms are distributed in the premises both of which are ex *hypothesi* the middle term. The conclusion is O, which distributes the major term. But the major term cannot be distributed in the major premise, since no term is left distributed there.

The combination AE distributes three terms, two of which are *ex hypothesi* the middle term. The conclusion must be negative and the major term is distributed. So the mood AE necessarily commits the fallacy of Illicit Major since the major premise cannot distribute the major term. The mood EA, however, is free from this fallacy. But since it cannot distribute the minor term, the conclusion cannot be E. So, the only possible conclusion is O.

The combination AA distributes two terms, both of which are *ex hypothesi* the middle term. No other term is distributed in the premises. The conclusion, which is affirmative, cannot therefore be A. So, the only possible conclusion is I.

Thus, if the middle term is distributed twice, the conclusion must be particular.

9. *If in a syllogism only two terms are distributed twice, the conclusion must be O.*

Proof : Here, of the two distributed terms, one must be the middle term to avoid the fallacy of Undistributed Middle. If the middle term is distributed twice, the conclusion must be particular, i.e., I or O. If it is I, neither the minor nor the major term can be distributed. So, the condition 'two terms distributed twice' cannot be fulfilled. Thus, the only possibility left is that the conclusion is O. The premises, here, are EA and the mood is EAO.

10. *If the minor term is predicate in the minor premise, the conclusion cannot be A.*

Proof : The minor term in the minor premise is either distributed or undistributed. If it is distributed, the minor premise is negative. So, the conclusion cannot be affirmative, i.e., the conclusion cannot be A. If it is undistributed, it cannot be distributed in the conclusion. So the conclusion cannot be universal, i.e., the conclusion cannot be A.

Thus, if the minor term is predicate in the minor premise, the conclusion cannot be A.

EXERCISE

1. Explain the characteristics of Syllogism. What are its constituents ?
2. What is meant by the terms 'Figures' and 'Moods' of syllogism ? State the following in logical order and determine the figure and mood in each case.
   (a) All men are not selfish; because some men are benevolent and such people cannot be said to be selfish.
   (b) Wise people are spiteless. Those who are satisfied in their lot are spiteless. So those who are satisfied in their lot are wise.
   (c) Some students are intelligent and some students are dishonest. So there is no doubt that some intelligent persons are also dishonest.
   (d) Only educated people are fit to be administrators of the country. Some educated people are fickle-minded. So fickle-minded people are fit to be administrators of the country.
3. Give reasons for the following :
   (a) The middle term should be distributed at least once.
   (b) At least one premise of a syllogism should be universal.
   (c) At least one premise of a syllogism should be affirmative.
   (d) The undistributed terms in the premise should remain undistributed in the conclusion.
4. Write short notes with suitable examples on the following fallacies:
   (a) Four terms

(b) Undistributed Middle
(c) Illicit Minor
(d) Illicit Major
(e) Two negative premises
(f) Two particular premises.

Q 5. Determine the valid moods of the third and fourth figures by the General Syllogistic Rules.

6. State and explain the Special Syllogistic Rules of the Second Figure and determine with the help of them the valid moods of the figure.

7. Analyse the implication of the dictum 'de omni et nullo.'
Why is the first figure called the Perfect Figure ?

8. Reduce both directly and indirectly:
(a) Baroco
(b) Bocardo
(c) Bramantip
(d) Camestres
(e) Felapton.

9. Write notes on :
(a) Fundamental moods
(b) Strengthened moods
(c) Weakened moods
(d) Perfect moods
(e) Imperfect figures.

10. Show how the following conclusions can be reached. Name all the moods in each case.
(a) All crows are biped.
(b) No roses are fruits.
(c) Some P is Q.
(d) Some P is not Q.

11. Prove the following :
(a) When one premise is particular, the conclusion must be particular, but when the conclusion is particular, it is not binding that one premise must be particular.

(b) In Fig. IV, O cannot be a premise and A cannot be the conclusion.

12. State the following arguments in logical order and test their validity.

(a) All men are not hard-working. Ram is hard-working. So, Ram is not a man.

(b) This student is intelligent, because he is promoted to the higher class and only those who are promoted to the higher class are intelligent.

(c) Proper education makes a man cultured. This man is not educated. How can he be cultured ?

(d) The Moon goes round the Earth. The Earth goes round the Sun. So, the Moon goes round the Sun.

(e) Sin is punishable. Sin is an act of man. So, all human actions are punishable.

(f) Most film-stars are handsome. Most film-stars are rich. So, most rich people are handsome.

(g) No men are beasts. No beasts are birds. So no men are birds.

(h) No men are horned animals. All men are wingless. So no wingles animals are horned.

8

Mixed and Abbreviated Syllogism

Traditionally, syllogisms are divided into pure and mixed. In a pure syllogism all the constituent propositions are of the same type, but in a mixed syllogism the constituent propositions are of different types.

In the previous chapter all that we discussed is about the Pure Categorical Syllogism. Other forms of Pure Syllogisms may be illustrated thus:

Pure Hypothetical

If p, then q.
If q, then r.
∴ If p, then r

If A is B, C is D.
If C is D, E is F.
∴ If A is B, E is F.

If a man works sincerely, he is successful.
If a man is successful, he gets happiness.
∴ If a man works sincerely, he gets happiness.

Pure Alternative

A is either B or C.
C is either E or F.
∴ A is either B or E or F.

All triangles are either equilateral or non-equilateral.
All non-equilateral triangles are either isosceles or scalene.
∴ All triangles are either equilateral or isosceles or scalene.

It may be noted that what has been stated here as pure Alternative Syllogism was called by the Traditional Logicians as Pure

Disjunctive Syllogism; the distinction between Alternative and Disjunctive propositions was made only by the Modern Logicians. According to the modern terminology this form of reasoning would be Pure Alternative Syllogism.

Mixed Syllogisms are of several forms. They are compound modes of arguments with one or more composite premises.

If in a syllogism one premise is Hypothetical and the other premise is Categorical, the syllogism is called Hypothetical-Categorical Syllogism or Mixed Hypothetical Syllogism, e.g.,

If p, then q.	If A is B, C is D.
p.	A is B.
∴ q.	∴ C is D.

If in a syllogism, one premise is Alternative and the other premise is Categorical, the syllogism is called Alternative-Categorical Syllogism or Mixed Alternative Syllogism, e.g.,

Either p or q.	Either A is B or C is D.
not p.	A is not B.
∴ q	∴ C is D.

If in a syllogism, one premise is Disjunctive and the other premise is Categorical, the syllogism is called Disjunctive-Categorical Syllogism or Mixed Disjunctive Syllogism, e.g.,

Not both p and q	Not both that A is B and C is D.
p.	A is B
∴ not q	∴ C is not D.

Besides these, another form of a mixed syllogism has also drawn the attention of logicians, which is called Dilemma. In a dilemma one premise is Compound-Hypothetical and the other premise is Alternative, e.g.,

If p, then q.	If A is B, C is D.
& If r, then s.	& If X is Y, M is N.
Either p or r.	Either A is B or X is Y.
∴ Either q or s.	∴ Either C is D or M is N.

We have seen in Chapter V that every form of composite proposition can be transformed into equivalent composite propositions of other forms. So, the mixed syllogisms with one composite premise are also mutually transformable. Thus the following syllogisms are equivalents.

Mixed Hypothetical Syllogism

If there is the Sun, there is light.
There is the Sun.
∴ There is light.

Mixed Alternative Syllogism

Either there is no Sun or there is light.
There is the Sun.
∴ There is light.

Mixed Disjunctive Syllogism

Not both that there is the Sun and there is no light.
There is the Sun.
∴ There is light.

Mixed Hypothetical Syllogism

As has been stated above, the Mixed Hypothetical Syllogism has a hypothetical premise and a categorical premise. The conclusion here is categorical.

The rules governing this form of inference are:

(1) By affirming the antecedent, we affirm the consequent but not conversely.

(2) By denying the consequent, we deny the antecedent, but not conversely.

It should be noted that the hypothetical premise may state a general rule, while the categorical premise and the conclusion may affirm or deny special cases falling under the general rule.

The relation between the antecedent and the consequent is similar to the relation of one of the causes of an effect and the effect. If the effect is produced at different times by different causes, then the presence of a cause necessarily implies the presence of the effect, but the presence of the effect does not imply the presence of that particular cause. As for example, if the head of a man is cut off, he dies; but if a man dies, we cannot presume that his head must have been cut off. He might as well have died for some other reason. So, by the assertion of the antecedent, we can assert the consequent; but by the assertion of the consequent, we cannot assert the antecedent.

When, however, the effect does not take place, none of its causes can be present. So, by denying the consequent, the antecedent is denied. Again, the absence of a particular cause does not necessarily imply the absence of the effect. The effect may still be there, because of some other cause. So, by the denial of the antecedent, the consequent is not necessarily denied. Thus by denying death, we can deny the cutting off of the head; but by denying the cutting off of the head, we cannot deny death.

When the relation of the antecedent and the consequent is like the relation between an only cause and its only effect, then by the assertion or denial of the antecedent we can respectively assert or deny the consequent and *vice versa*, e.g., If a triangle is equilateral, it is equiangular. Here, by asserting the antecedent we can assert the consequent and by denying the antecedent we can deny the consequent. Similarly, by asserting the consequent, we can assert the antecedent and by denying the consequent, we can deny the antecedent. In such a case, the hypothetical proposition is expressed in the form: If and only if A is B, then C is D.

Forms of Mixed Hypothetical Syllogism

Mixed Hypothetical Syllogisms may be of two forms. The application of the first rule gives rise to the *Modus Ponens* or the *Constructive form* of the Mixed Hypothetical Syllogisms, while the application of the second rule gives rise to the *Modus Tollens* or the *Destructive form* of the Mixed Hypothetical Syllogisms. The qualitative difference of the antecedent and the consequent gives four variations to each of these forms. Let us illustrate these different forms of Mixed Hypothetical Syllogism.

The following four Constructive forms of this kind of Syllogism are valid, since they are in accordance with Rule 1 :

1. If A is B, C is D.
   A is B.
∴ C is D.

If there is the Sun, there is light.
   There is the Sun.
∴ There is light.

2. If A is B, C is not D.
   A is B.
∴ C is not D.

If a man takes proper preventive measures, he does not suffer from small-pox.
   You have taken proper preventive measures.
∴ you will not suffer from small-pox.

3. If A is not B, C is D.
   A is not B.
∴ C is D.

If there is no financial stability, business is hampered.
   He is not financially stable.
∴ His business will be hampered.

4. If A is not B, C is not D.
   A is not B.
∴ C is not D.

If you do not invite him, he will not come.
   You have not invited him.
∴ He will not come.

In each of these above cases, if we assert the antecedent in the conclusion by asserting the consequent in the premise, the syllogism is invalid, because in that case Rule 1 is violated, e.g.,

If A is B, C is D.
   C is D.
∴ A is B.

If there is the Sun, there is light.
   There is light.
∴ There is the Sun.

This argument is obviously fallacious and the fallacy is called *'the fallacy of affirming the consequent'*. It should be noted, however, that where the antecedent states the only cause of the consequent, no fallacy arises even if Rule 1 is violated (*Vide page 193*).

The following four Destructive forms of this kind of Syllogism are valid, since they are in accordance with Rule 2 :

If A is B, C is D.
1. C is not D.
∴ A is not B.

If there is the Sun, there is light.
There is no light.
∴ There is no Sun.

If A is B, C is not D.
C is D.
∴ A is not B.

If a man takes proper preventive measures, he does not suffer from small–pox.
You are suffering from small-pox.
∴ You did not take proper preventive measures.

If A is not B, C is D.
C is not D.
∴ A is B.

If there is no financial stability, business is hampered.
His business is not hampered.
∴ He is financially stable.

If A is not B, C is not D.
C is D.
∴ A is B.

If you do not invite him, he will not come.
He must come.
∴ You must invite him.

In each of these above cases, if we deny the consequent in the clusion by denying the antecedent in the premise, the syllogism nvalid because in that case Rule 2 is violated, e.g.,

If A is B, C is D.
A is not B.
∴ C is not D.

If there is the Sun, there is light.
There is no Sun.
∴ There is no light.

This argument is obviously fallacious, because even if there be no Sun, there may still be light, because of electricity or fire or moon etc. This type of fallacy is called the fallacy of *'denying the antecedent.'* It should be noted, however, that when the antecedent states the only cause of the consequent no fallacy arises even if Rule 2 is violated *(Vide page 193)*.

Mixed Alternative Syllogism

It has been already said that the Mixed Alternative Syllogism has an alternative proposition as one premise and a categorical proposition as the other premise. The conclusion here is either Categorical or Alternative. If there be only two alternants in the alternative premise, the conclusion is always Categorical. If there be more that two alternants in the alternative premise, and all the alternants except one are denied by the other premise, then also the conclusion is Categorical. But if more than one alternant are left undenied, then the conclusion becomes alternative in order to assert the undenied alternants.

According to Mill, the rule of this kind of syllogism is that by denying some alternants in the premise, we can affirm the remaining alternants in the conclusion, but not conversely, i.e., by affirming some alternants, we cannot deny the other alternants. Ueberweg, however, holds the view that by affirming one alternant in the premise, we can also deny the others in the conclusion.

It should be noted here again that the Alternative premise may state a general rule but the categorical premise and the conclusion may deny or affirm special cases falling under the general rule.

Forms of Mixed Alternative Syllogism

Mixed Alternative Syllogisms may be of two forms since the conclusion may be either Categorical or Alternative.

he following forms of syllogism, where the conclusion is ategorical, are valid.

Either A is B or C is D.
A is not B.
∴ C is D.

Either Ram is intelligent or he is diligent.
Ram is not intelligent.
∴ He is diligent.

A is either B or C or D.
A is neither B nor C.
∴ A is D.

A triangle is either equilateral or isosceles or scalene.
This triangle is neither equilateral nor isosceles.
∴ This triangle is scalene.

The following forms of this syllogism, where the conclusion is ernative, are also valid.

A is either B or C or D.
A is not B.
∴ A is either C or D.

Film-stars are either handsome or talented or well-connected.
This film-star is not handsome.
∴ She is either talented or well-connected.

A is either B or C or D or E.
A is neither B nor C.
∴ A is either D or E.

He at this time will be either at home or in the office or in the ground or in the park.
He is neither at home nor in the office.
∴ He is either in the playground or in the park.

According to Mill, if by affirming some alternative in the ise, we deny the others in the conclusion, the syllogism is id. Thus the following forms are invalid.

A is either B or C.
A is B.
∴ A is not C.

2. A is either B or C or D.
A is B.
∴ A is neither C nor D.

As has been stated above, Ueberweg takes these forms to be valid. The difference in the opinions of Mill and Ueberweg is due to the difference in their interpretation of the meaning of Alternative proposition. According to Mill, the Alternative proposition asserts that *at least one* of the alternatives is true; but according to Ueberweg the Alternative proposition asserts that *only one* alternative is true. In practice, however, alternative propositions are used in both these senses. So if we take the minimum interpretation, Mill's view will be always true. Ueberweg's view is true only in special cases where the alternants are mutually exclusive, e.g.,

Triangles are either right–angled or obtuse–angled or acute-angled.
This triangle is right-angled.
∴ This triangle is neither obtuse-angled nor acute angled.

Mixed Disjunctive Syllogism

It has been said above that the Mixed Disjunctive Syllogism ha a disjunctive proposition as one premise and a categorical proposition as the other premise. The conclusion here is Categorical.

The rule governing this form of reasoning is that by affirmin one disjunct we can deny the other disjuncts. Two disjuncts canno be taken toghther; so the assertion of one necessarily leads to th denial of the other. In this case also the disjunctive premise ma state a general rule, but the categorical premise and the conclusio may affirm or deny special cases covered by the general rule. Th following form of this syllogism is valid.

Not both that A is B and C is D.
A is B.
∴ C is not D.

Not both that most Indians are poor and India is a high prosperous country.

Most Indians are poor.

∴ India is not a highly prosperous country.

Though the disjuncts cannot be true together, they can both be lse. So we cannot, by denying one of the disjuncts in the premise, firm the others in the conclusion.

So the following form of the syllogism is invalid.

Not both that A is B and C is D.

A is not B.

∴ C is D

Not both that a man at the same moment be at Cuttack and at elhi.

Ram is not at Cuttack.

∴ He is at Delhi.

This is obviously wrong because Ram may be neither at Cuttack r at Delhi, but be elsewhere.

The result of the above discussion on the Mixed Syllogisms may summarised in a tabular form. The following modes are valid :

ms of Composite premise	*Name of the Mode of reasoning*	*Example of the Mode of reasoning*
Hypothetical	Ponendo Ponens (by affirming, affirms)	If p, then q. p. ∴ q.
Hypothetical	Tollendo Tollens (by denying, denies)	If p, then q. not q. ∴ not p.
Alternative	Tollendo Ponens (by denying, affirms)	Either p or q. not p. ∴ q.
Disjunctive	Ponendo Tollens (by affirming, denies)	Not both p & q. p. ∴ not q.

It may be noted that in respect of the Mixed Hypothetical Syllogism, Ponendo Ponens Mode of reasoning becomes invalid if by affirming the consequent in the premise, we affirm the antecedent in the conclusion. Similarly, in this kind of syllogism, Tollendo Tollens Mode of reasoning becomes invalid if by denying the antecedent in the premise, we deny the consequent in the conclusion. Again, in respect of Mixed Alternative Syllogism, Ponendo Tollens Mode of reasoning is invalid and in respect of Mixed Disjunctive Syllogism, Tollendo Ponens Mode of reasoning is invalid.

Every form of Mixed Syllogism, whether valid or invalid, can be reduced to equivalent forms of Pure Syllogism. We will give here illustrations of some equivalent fallacies.

Fallacy of affirming the consequent (Ponendo Ponens) = Fallacy of Undistributed Middle.

If p, then q.	=	All cases of P are cases of q.
q.		It is a case of q.
∴ p.		∴ It is a case of p.

Fallacy of denying the antecedent (Tollendo Tollens) = Fallacy of Illicit Major.

If p, then q.	=	All cases of P are cases of q.
not p.		It is not a case of p.
∴ not q.		∴ It is not a case of q.

Fallacy of denying an alternant by affirming the other (Ponendo Tollens) = Fallacy of Undistributed Middle.

Either p or q.	=	All cases of not q are cases of p.
p.		It is a case of p.
∴ not q.		∴ It is a case of not q.

Fallacy of affirming a disjunct by denying the other. (Tollendo Ponens) = Fallacy of Undistributed Middle.

Not both P and q.	=	All cases of q are cases of not p.
not p.		It is a case of not p.
∴ q.		∴ It is a case of q.

Dilemma

Dilemma is a mixed syllogism of which one premise is Compound Hypothetical, the other premise is Alternative and the conclusion is either Categorical or Alternative.

If the Compound Hypothetical premise consists of two hypothetical propositions, the reasoning is called Dilemma. If it consists of three hypothetical propositions, the reasoning is called Trilemma. Similarly, we may have Tetralemma or Quadrilemma, Pentalemma, Hexalemma, etc., according as the number of hypothetical propositions is four, five, six, etc. These may be also called by the general name Polylemma.

In a dilemmatic argument the alternatives presented in the Hypothetical premise appear to be exhaustive. So, one of them must be accepted, but whichever be accepted, the result is embarrassing. So, this form of argument is usually advanced in order to put an opponent in a state of indecision or helplessness.

Rules to Secure Formal Validity of Dilemma

1. If the antecedents of the Compound Hypothetical premise be alternatively affirmed by the other premise the consequents can be alternatively affirmed in the conclusion, but not conversely.

2. If the consequents of the Compound Hypothetical premise be alternatively denied by the other premise, the antecedents can be alternatively denied in the conclusion, but not conversely.

It may be seen that these two rules are similar to the rules of the Mixed Hypothetical Syllogism. So, they can be justified in the same manner.

Further, it may be noted that for the application of Rule 1, the antecedents of the Compound Hypothetical premise must be different so that they can be alternatively affirmed in the Alternative premise, but the consequents need not be different. Where the consequents are the same, we get a Categorical proposition as the conclusion, but where the consequents are different, we get an Alternative proposition as the conclusion.

Similarly, for the application of Rule 2, the consequents must be different in order to be denied alternatively by the alternative premise, but the antecedents may be same or different. Where the antecedents are same, we get a Categorical conclusion, and where they are different, we get an Alternative conclusion. In the case of a dilemma also, the compound hypothetical premise may state a general rule, but the alternative premise and the conclusion may be about special cases covered by the general rule.

Forms of Dilemma

Dilemma may be either *Constructive* or *Destructive* according as the antecedents are affirmed or the consequents are denied in the premise. They may be also either *Simple* or *Complex* according as the conclusion is Categorical or Alternative. So we get four forms of Dilemma.

1. Simple Constructive
2. Complex Constructive
3. Simple Destructive
4. Complex Destructive.

1. *Simple Constructive Dilemma*

If A is B, C is D;
& If E is F, C is D.
Either A is B or E is F.
∴ C is D.

If you are fated to be cured, consulting the physician is unnecessary.
If you are not fated to be cured, consulting the physician is unnecessary.
Either you are fated to be cured or not fated to be cured
∴ Consulting the physician is unnecessary.

2. *Complex Constructive Dilemma*

If A is B, C is D;
& If E is F, G is H.
Either A is B or E is F.
∴ Either C is D or G is H.

If these books contain the same doctrines as the Koran, they are superfluous.
If they are at variance with it, they are pernicious.
Either they contain the same doctrines as the Koran or are at variance with it.

∴ They are either superfluous or pernicious.

It is said that Caliph Omar, the conqueror of Egypt, put the Custodians of the Alexandrian Library in this dilemma.

3. *Simple Destructive Dilemma*

If A is B, C is D;
& If A is B, E is F.
Either C is not D or E is not F.
∴ A is not B.

If a man is to be successful in life, he must be intelligent.
If a man is to be successful in life, he must be diligent.
This child is either not intelligent or not diligent.
∴ He cannot be successful in life.

4. *Complex Destructive Dilemma*

If A is B, C is D;
& If E is F, G is H.
Either C is not D or G is not H.
∴ Either A is not B or E is not F.

If he would have been intelligent, he would have realised his mistakes.
If he would have been honest, he would have admitted himself to be wrong.
Either he does not realise his mistakes or does not admit himself to be wrong.
∴ He is either not intelligent or not honest.

Test of the validity of Dilemmas

The formal validity of dilemmas can be tested by the application of the rules stated above or by analysing it into its constituent Hypothetical Categorical Syllogisms and then applying the rules regarding them. All the above dilemmas are formally valid, since they are in accordance with the rules.

It may be seen that the following forms of dilemmas are invalid, because they violate the rules.

1. If A is B, C is D;
If A is B, E is F.
Either C is D or E is F.
∴ A is B.

This obviously violates Rule 1 stated above. It may be also shown that the constituent Mixed Hypothetical Syllogisms commit the fallacy of affirming the consequent thus:

(a) If A is B, C is D.
C is D.
∴ A is B.

(b) If A is B, E is F.
E is F.
∴ A is B.
Now either C is D or E is F.
∴ A is B.

2. If A is B, C is D.
If E is F, G is H.
Either A is not B or E is not F.
∴ Either C is not D or G is not H.

This violates Rule 2 of the dilemmatic argument and therefore is invalid. It can also be analysed into two Mixed Hypothetical Syllogisms and each one of them would commit the fallacy of Denying the antecedent.

It may be remarked that since dilemmas are advanced in order to put an opponent in an embarrassing situation, they are constructed in such a manner that formally they are irrefutable. The premises, however, are usually materially false or the alternatives suggested are not exhaustive. So in order to declare a dilemma to be sound, it is necessary to examine whether the premises are significant, pertinent and true and whether the alternants are exhaustive leaving no way of escape.

Refutation of Dilemmas

A dilemma is said to be refuted when its incorrectness is exposed. It is formally refuted, if it is shown that it violates some rule, and thus is invalid as a mode of reasoning. It is materially refuted, when it is shown that a premise or the premises are materially false or it is possible to arrive at an opposite conclusion by taking premises consistent with the proposed ones. This latter form of refutation is called Rebuttal.

The alternants of the dilemma (di=two, lemma=horns) are supposed to be like the two horns of a dangerous animal and the opponent is made to realise that he is between these two horns. The methods of refutation also bear names in accordance with this simile.

1. *Taking by one horn*—This mode of refutation consists in showing that one of the constituent propositions of the Compound-Hypothetical premise is materially false. For example, in the case of the above cited Complex destructive dilemma, it may be argued that the Hypothetical proposition 'If he would have been intelligent, he would have realised his mistakes' is wrong. It may be that 'since he is intelligent, he has realised that he is not mistaken'. This may be admitted and the dilemma is thus refuted by taking one horn.

2. *Taking by both horns*—This mode of refutation consists in showing that both the constituent propositions of the Compound-Hypothetical premise are materially false. For example, in the case of the above cited Complex destructive dilemma, it may be argued hat 'since he is intelligent, he realises that he is not mistaken and ince he is honest he straight-forwardly declares himself to be so'. This may be admitted and the dilemma is refuted by taking both the orns.

3. *Escaping between the horns*—This mode of refutation consists in showing that the alternatives proposed are not exhaustive nd so there is the possibility of another alternative. For example, n the case of the above cited Simple constructive dilemma, it may e argued that besides the two alternatives, i.e., (1) fated to be cured even if the physician is *not* consulted and (2) fated not to be cured even if the physician is not consulted, there is the third alternative

i.e., fated to be cured with the treatment of the physician. So the dilemma is refuted and the mode of refutation here is escaping between the horns.

4. Rebuttal—This mode of refutation consists in presenting a counter dilemma with premises consistent with the proposed premises of the Original dilemma. The counter-dilemma is constructed by taking the antecedents as they are, but joining to them consequents which are opposite of the original consequents and reversing their order. This gives a conclusion which is the opposite of the conclusion arrived at by the Original dilemma. For example, in the case of the above cited Complex constructive dilemma, the following counter dilemma may be presented.

If these books contain the same doctrines as the Koran, they are not pernicious.
If they are at variance with it, they are not superfluous.
Either they contain the same doctrine as the Koran or are at variance with it.
∴ They are either not pernicious or not superfluous.

The counter-dilemma may be admitted to be equally justified as the original dilemma and thus the inevitability of the conclusion of the original dilemma is lost and the weakness of the argument is exposed.

It may be noted that rebuttal is possible only in the case of Complex constructive form of dilemma. Since the antecedents are retained unchanged and the same Alternative premise is constructed with them, both the Original and the Counter dilemmas cannot be destructive. Again the original dilemma cannot be simple, because in that case, the transposition of the consequent would be meaningless. So in order to be rebutted the dilemma must be constructive and complex.

Classical Examples of Dilemmas and their Rebuttal

1. An Athenian mother in order to dissuade her son from entering into public life is said to have advanced the following dilemma:

If you act justly, men will hate you.
If you act unjustly, gods will hate you.
Either you will act justly or you will act unjustly.
∴ Either men will hate you or gods will hate you.

The son is said to have rebutted the mother's dilemma by the ollowing counter-dilemma.

If I act justly, gods will not hate me.
If I act unjustly, men will not hate me.
Either I act justly or I act unjustly.
∴ Either gods will not hate me or men will not hate me.

2. A crocodile seized the child of a woman and when requested o return the child, promised to do so, if the mother could tell him ight whether he intends to give it back. The mother said "you will ot give it back" and then she advanced the following dilemma:

If my statement be true, you must return the child according to your promise.
If my statement be false, you must return the child in order to prove it to be false.
My statement is either true or false.
∴ In any case ,you must return the child.

The crocodile rebutted the dilemma in the following way:

If your statement is false, I cannot return the child according to my condition.
If your statement is true, I cannot return the child since then your statement becomes false.
Your statement is either true or false.
∴ In any case, I cannot return the child.

3. Protagoras undertook to train Euathlus for the bar on the ndition that half of the fee should be paid in advance and the other f be paid when Euathlus won his first case. Euathlus, however, ayed payment of the other half by not appearing in the court as Advocate. So Protagoras sued him and advanced the following mma:

Beside these, a fourth form of Enthymeme is also recognised by some logicians, where only one proposition, under suitable circumstance, has a syllogistic force. So all told Enthymeme may be of four different orders.

Enthymeme of the First Order

An Enthymeme of the First Order is one, where the major premise is suppressed and only the minor premise and the conclusion are explicitly stated, e.g.,Ram is mortal, because he is a man.

'This triangle is neither equilateral nor isosceles; therefore,it is scalene' is also an enthymeme of this order. Here the suppressed major premise is 'All triangles are either equilateral or isosceles or scalene'. Similarly, 'Since this ring has a diamond, it is costly'. 'It cannot be evening, because the Sun is in the Eastern horizon', etc. are Enthymemes of the First Order.

Enthymeme of the Second Order

An Enthymeme of the Second Order is one, where the minor premise is suppressed and only the major premise and the conclusion are explicitly stated, e.g., Ram is mortal, because all men are so.

'If a man is diligent, he is sure to succeed in life; therefore, Ram is sure to succeed in life' is also an enthymeme of this order. Here the suppressed minor premise is 'Ram is diligent'. Similarly, 'All diamond rings are costly; so this ring is costly'; 'One cannot both be honest and grow rich; so you can never grow rich', etc. are Enthymemes of the Second Order.

Enthymeme of the Third Order

An Enthymeme of the Third Order is one where the conclusion is suppressed and only the premises are explicitly stated, e.g., All men are mortal and Ram is a man.

'If the bone is broken, there is severe pain; and you are not having severe pain ' is also an enthymeme of this order. Here the suppressed conclusion is 'Your bone is not broken'. Similarly, 'All diamond rings are costly and this is a diamond ring', 'The only means f conveyance from this place is either bus or hired taxi and bus-drivers are on strike to-day', etc. are Enthymemes of the Third Order.

Enthymeme of the Fourth Order

An Enthymeme of the Fourth Order is one, where two proposi-ions are suppressed. So it consists of only one proposition, but this single proposition has a syllogistic force because of the circumstances under which it is expressed. The syllogistic force can be generated under suitable circumstances by stating only the major premise or only the minor premise or only the conclusion. The father finding his son neglecting his studies may remark "My boy, all who neglect their studies mourn in later life". Here he has stated only the major premise. The minor premise 'You are neglecting your studies' and the conclusion 'You will mourn in later life' have been kept in mind. Similarly, learning that the son has failed in the Examination the father may say, "Was he not neglecting his studies ?" meaning thereby that "All who neglect their studies fail in the Examination; he was neglecting his studies; therefore he has failed in the Examination'. Here only the minor premise is stated. Similarly, one may find that a little child is playing with a sharp blade and warns the parents, "Look here, your child may cut his finger". Here only the conclusion has been stated and the premises are expected to be understood.

Such propositions should be distinguished from the propositions which are used to give information or cited as illustrations. A child may inform his parents that his class friend is neglecting his studies or somebody has cut his finger. These are simply propositions and not enthymemes. Similarly, the Grammar teacher, in order to explain the meaning of subject and predicate, cites the example of 'Ram is mortal'; this is not an enthymeme but simply a sentence.

An Enthymeme is not less useful than a fully expressed syllogism but its utility depends on its being understood properly. Where it consists of one proposition only, the other propositions can be known from the situation. Where two propositions are stated, the omitted proposition can be constructed by the terms used in the stated propositions. Brevity is the soul of wit; but in doubtful cases it is desirable that a demand be made on the speaker to supply the omitted part so that there be no misunderstanding.

EXERCISE

1. Distinguish between Pure and Mixed Syllogism. Illustrate how the same argument can be presented in different modes of mixed syllogism.
2. Explain the rules of Hypothetical-Categorical Syllogism and determine the valid forms of argument of this kind of syllogism.
3. What is Mixed Alternative Syllogism ? Explain the difference of opinions between Mill and Ueberweg with regard to this form of reasoning.
4. Explain Mixed Disjunctive Syllogism. Compare this form of reasoning with Mixed Alternative Syllogism.
5. Explain and illustrate the following :
   (a) The fallacy of affirming the consequent
   (b) The fallacy of denying the antecedent
   (c) Tollendo Ponens mode of reasoning
   (d) Ponendo Tollens mode of reasoning.
6. What is Dilemma ? What are its different forms ? Give examples.
7. How are dilemmas refuted ?
8. What is Enthymeme ? What are its different orders ?
9. Write short notes with examples on :
   (a) Counter dilemma
   (b) Enthymeme of the Fourth Order
   (c) Invalid form of Ponendo Tollens and Tollendo Ponens.
10. Test the following arguments :
    (a) If a man steals; he is afraid of the Police. If he has not stolen, why is he afraid of the Police ?
    (b) If a man is not brave, he does not choose to be a soldier. Radhu does not choose to be a soldier. So he is not brave.

(c) You learn an art well, if you have an aptitude for it. He has no aptitude for music. How can he be a good musician ?

(d) That girl must be either an Oriya or a Bengali or an Assamese. You say that she is not an Oriya. So she must be either a Bengali or an Assamese.

(e) A poor man either begs, borrows or steals.
This poor man is begging.
∴ He neither borrows nor steals.

(f) It cannot be both that you shoulder no responsibility and still you hold a high post in the Government. He does not hold a high post in the Government. So he shoulders no responsibility.

(g) If you accept the appointment, you cannot continue your studies. If you do not accept the appointment, you will starve. So you have no other alternative but to starve or to discontinue your studies.

(h) If you want peace in life, you shall have to give up ambition. If you want peace in life, you shall have to believe in Fate. He is either unable to give up ambition or unable to be a fatalist. So he cannot have peace in life.

(i) The weather is cloudy, and the wind is cold.
∴ There will be rain.

(j) All birds are biped. So, this animal must be a bird.

(k) The teacher is too good to take revenge.

9

Deductive Fallacies

The term Fallacy comes from the Latin word *fallacia* and ordinarily means error or confusion. So, Deductive Fallacies are the errors or confusions which may arise in respect of the subject-matter of Deductive Logic. Deductive fallacies, in a broad sense, therefore, mean all sorts of errors that may arise whether concerning Definition, Division,etc., or concerning inferences. So, Deductive Fallacies may be of two kinds, viz., (1) Non-inferential and (2) Inferential. Besides these, errors are also possible in deductive logic because of the ambiguity in language. Such fallacies are called *Semilogical Fallacies.*

Non-Inferential Deductive Fallacies

These fallacies arise due to the violation of rules concerning Definition, Division etc., which are not themselves inferences but processes subsidiary to deductive inferences. The fallacies concerning Definition are Redundant, Accidental, Too wide, Too narrow, Incomplete, Obscure, Figurative, Synonymous, Circular and Negative Definitions. The fallacies concerning Division are Metaphysical, Physical, Cross, Too narrow, Too wide, Overlapping Divisions and Division by a leap. All these fallacies have been dealt with in connection with the rules they violate.

Inferential Deductive Fallacies

These fallacies include fallacies of immediate inference and those of mediate inference. They have been dealt with in connection with the rules they violate. Some prominent forms of them may be estated here for the sake of a clear vision of the pitfalls against hich we must guard.

allacies of Immediate Inference

1. The general rule in the case of deductive reasoning is that n undistributed term of the premise cannot be distributed in the onclusion. So, wherever this rule is violated, the reasoning is allacious.

a) *Simple Conversion of A*

All men are animals—A.

∴ All animals are men—A.

Here, the term 'animals' is undistributed in the premise but istributed in the conclusion.

Where the predicate of A is co-extensive with the subject, imple conversion of A is not fallacious.

e.g.,
All men are rational animals—A.
∴ All rational animals are men—A.
The Moon is the only satellite of the Earth—A.
∴ The only satellite of the Earth is the Moon—A.

(b) *Conversion of O*

Some animals are not men—O.

∴ Some men are not animals—O.

Here, the term 'animals' is undistributed in the premise, but distributed in the conclusion.

(c) *Contraposition of I*

Some men are honest persons—I.

∴ Some dishonest persons are not men—O.

Here, the term 'men' is undistributed in the premise, but distributed in the conclusion.

2. *Fallacies concerning Inversion*

The inverse of a proposition is obtained by applying the processes of conversion and obversion alternately starting with either conversion or obversion whichever gives the conclusion. By this process it is known that the inverse of a universal proposition is particular and a particular proposition has no inverse. So the following reasonings are fallacious.

All men are mortal—A.
∴ All not-men are immortal—A.
or No not-men are mortal—E.
No men are perfect—E.
∴ No not-men are imperfect—E.
or All not-men are perfect—A.
Some eatables are non-nutritious—I.
∴ Some non-eatables are nutritious—I.
or Some non-eatables are not non–nutritious—O.
Some animals are not mobile—O.
∴ Some not-animals are not not-mobile—O.
or Some non-animals are mobile—I.

3. Fallacy due to Material Obversion.

Though Bain considers material obversion to be a valid process, generally his view is not accepted since the rules concerning obversion are violated. So, the following reasonings are fallacious :

Days are hot.
∴ Nights are cold.
Teachers are wise.
∴ Students are fools.

4. Fallacies concerning Inference by Opposition

The truth or falsity of a proposition may leave the truth or falsity of another proposition with the same subject and the same predicate undetermined. If we infer determinate conclusions, we commit fallacies. So the following reasonings are fallacious.

Subalternation

All students of this College are intelligent—A—false.
∴ Some students of this College are intelligent—I—false.
No men are blind—E—false.
∴ Some men are not blind—O—false.
Some students of this College are intelligent—I—true.
∴ All students of this College are intelligent—A—true.

Some men are not selfish—O—true.

∴ No men are selfish—E—true.

trary Opposition

All the fruits of this garden are sweet —A—false.

∴ No fruits of this garden are sweet—E–true.

No men are blind—E—false.

∴ All men are blind—A—true.

contrary Opposition

Some fruits of this garden are sweet—I—true.

∴ Some fruits of this garden are not sweet—O—false.

Some men are not selfish—O—true.

∴ Some men are selfish—I—false.

llacies of Mediate Inference

Fallacy of Four Terms

In every syllogism there should be three and only three terms. if there be four terms in a reasoning which is supposed to be a llogism, it gives rise to this fallacy.

God is the Creator of man.
Man is the Creator of sin.
∴ God is the Creator of sin.

Here, there are four terms : God, creator of man, man and reator of sin.

West Bengal is included in India.
Orissa is not included in West Bengal.
∴ Orissa is not included in India.

Here, there are four terms : West Bengal, included in West Bengal, Orissa, and included in India.

2. *Fallacy of Undistributed Middle*

According to General Syllogistic Rules, the middle term must be distributed at least once. So a syllogism, where the middle term is not at all distributed, is fallacious :

All men are biped—A.
All birds are biped—A.
∴ All birds are men—A.

Here, the middle term 'biped' is not distributed in any premise.

Similarly,

All mangoes are fruits—A.
Some fruits are not sweet—O.
∴ Some mangoes are not sweet—O.

Here, the middle term 'fruits' is not distributed in any premise.

If, however, the premises are plurative and the syllogism is in Fig. III, the reasoning is not fallacious, though the middle term is not at all distributed.

Most actors are not good songsters.
Most actors are good artists.
∴ Some good artists are not good songsters.

3. *Fallacy of Illicit Minor*

This fallacy arises because of the violation in respect of the minor term of the general rule of deductive reasoning that the undistributed term of the premise cannot be distributed in the conclusion.

No cuckoo is crow—E.
All crows are birds—A.
∴ No bird is cuckoo—E.

Here, the minor term 'bird' is not distributed in the premise, but distributed in the conclusion.

Similarly,

All men are animals—A.
All animals are creatures—A.
∴ All creatures are men—A.

Here, the minor term 'creatures' is not distributed in the premise, but distributed in the conclusion.

4. *Fallacy of Illicit Major*

This fallacy arises because of the violation in respect of the Major term of the rule that the undistributed term of the premise cannot be distributed in the conclusion.

All men are biped—A.
No birds are men—E.
∴ No birds are biped—E.

Here, the major term 'biped' is not distributed in the premise, but distributed in the conclusion.

Similarly,

Some birds are crows—I.
No crows are cranes—E.
∴ Some cranes are not birds—O.

Here, the major term, 'birds' is not distributed in the premise, but distributed in the conclusion.

5. *Fallacy of Two Negative Premises*

This fallacy arises due to the violation of the General Syllogistic Rule that both the premises of a syllogism cannot be negative.

No circles are rectilinear—E.
No triangles are circles—E.
∴ No triangles are rectilinear—E.

It may be noted, however, that, two negative propositions containing a pair of contradictory terms, one in each, may lead to a conclusion, because one of them may be transformed, by immediate inference, to an affirmative proposition consequently giving a common middle term.

The following combination of propositions apparently gives no conclusion, since it gives rise to the fallacy of two negative premises as well as the fallacy of four terms; but it leads to a valid conclusion.

No uneducated men are professors—E. (i)
No educated men are fools—E.(ii)

By converting (i) we get : No professors are uneducated—E(iii)
By obverting (iii) we get : All professors are educated—A. (iv)
By combining (ii) and (iv) we get:

No educated men are fools—E.
All professors are educated—A.
∴ No professors are fools—E.

This is the valid mood Celarent in Fig. I.

OR

All professors are educated—A.
No educated men are fools—E.
∴ No fools are professors—E.

This is the valid mood Camenes in Fig. IV.

6. *Fallacy of two Particular Premises*

This fallacy arises due to the violation of the General Syllogistic Rule that both the premises of a syllogism cannot be particular.

Some men are virtuous—I.
Some men are vicious—I.
∴ Some vicious persons are virtuous—I.
Some mangoes are sweet—I.
Some fruits are not mangoes—O.
∴ Some fruits are not sweet—O.

These arguments also commit other fallacies. Thus the former argument commits the fallacy of Undistributed Middle and the latter argument, the fallacy of Illicit Major.

In spite of all these, when the premises are plurative propositions and the argument is in Fig. III a particular conclusion is justified though none of the premises is universal.

Most film actors are rich.
Most film actors are talented.
∴ Some talented people are rich.

7. *Fallacy of Affirming the Consequent*

In mixed Hypothetical Syllogism by affirming the antecedent we can affirm the consequent, but by affirming the consequent we cannot affirm the antecedent. The violation of this rule leads to the fallacy of Affirming the consequent.

If there is the Sun, there is light.
There is light.
∴ There is the Sun.

Where, however, the antecedent is the only cause of the consequent, by affirming the consequent we may affirm the antecedent.

If there is the Sun, there is Sunlight.
There is Sunlight.
∴ There is the Sun.

8. *Fallacy of Denying the Antecedent*

In mixed Hypothetical Syllogism by denying the consequent we can deny the antecedent, but by denying the antecedent we cannot deny the consequent. The violation of this rule leads to the fallacy of Denying the Antecedent.

If a knife is plunged into the heart of a man, the man dies.
No knife is plunged into the heart of this man.
∴ This man is not dead.

Where, however, the antecedent is the only cause of the consequent, by denying the antecedent we may deny the consequent.

If the function of the heart of a man stops, the man dies.
The function of the heart of this man has not stopped.
∴ The man is not dead.

9. *Fallacy of Denying an alternant by Affirming the other*

In Mixed Alternative Syllogism by denying one alternant we can affirm the other, but by affirming one alternant we cannot deny the other. The violation of this rule leads to the fallacy of Denying an alternant by Affirming the other.

Sita is either poor or unassuming.
Sita is poor.
∴ Sita is not unassuming.

Where, however, the alternants are mutually exclusive by affirming one alternant, we can deny the other.

Sita is either poor or rich.
Sita is poor.
∴ Sita is not rich.

10. *Fallacy of Affirming a disjunct by Denying the other*

In Mixed Disjunctive Syllogism by affirming one disjunct we can deny the other, but by denying one disjunct we cannot affirm the other. The violation of this rule leads to the fallacy of Affirming a disjunct by Denying the other.

Not both that a man fought with Clive and also became a minister in Independent India.
My great grand father did not fight with Clive.
∴ He must have become a minister in Independent India.

11. Fallacy of Dilemma

The formal fallacies of dilemma are Affirming the consequents or Denying the antecedents in the Alternative premise. Further, they may be refuted by taking the horns or escaping between the horns or by the process of rebuttal. Most dilemmas are formally valid but materially false. Their falsity may be exposed by one or the other of the above methods of refutation. Fallacies of Dilemma have been illustrated in the section on Dilemma.

Semilogical Fallacies

Semilogical fallacies are the errors which arise because of the ambiguity of language. The mere form of the argument does not appear to be violating any rule, but an examination of the meaning of the terms reveals the different senses in which they are used. So semilogical fallacies are due to the violation of the first and fundamental principle of Logic, i.e., every term should be used in the same sense all through the argument. Aristotle holds that these fallacies may be of six kinds, *viz.*, Fallacies of Equivocation, Composition, Division, Figure of speech, Amphiboly and Accent. Besides these, the fallacy of Accident may also be taken as a fallacy of this type. Let us discuss these one by one.

1. Fallacy of Equivocation

This fallacy arises due to the use of equivocal terms in argument. In a syllogism either the middle or the minor or the major term may be used equivocally, i.e., in two different senses in the two propositions containing it, giving rise respectively to the fallacy of Ambiguous Middle, Ambiguous Minor and Ambiguous Major.

Ambiguous Middle

Light is pleasant. (light = opposite of darkness)
His injury is *light*. (light = opposite of severe)
∴ His injury is pleasant.
The *end* of a thing is its perfection. (end = aim)
Death is the *end* of life. (end = termination)
∴ Death is the perfection of life.

Ambiguous Minor

The head-wear of a king is not a coin.
Crown is the head-wear of a king.
∴ *Crown* is not a coin. (crown = coin worth 5 shillings)
No kings are coins.
A *sovereign* is a coin. (sovereign = coin worth £ 1)
∴ A *sovereign* is not a king. (sovereign = monarch)

Ambiguous Major

Rational animals are *men*. (men = human beings)
Women are rational animals.
∴ Women are *men*. (men = male human beings)
No courageous creatures fly. (fly = run away)
Eagle is a courageous creature.
∴ Eagle does not fly. (fly = move through air with wings)

2. Fallacy of Composition

This fallacy arises if we proceed from the distributive use of a term to its collective use.

Two and three are even and odd. (taken separately)
Five is two and three. (taken jointly)
∴ Five is even and odd.
Neither Jadu nor Madhu nor Radhu can remove this log of wood. (independently)
Jadu, Madhu and Radhu are all the sons of Sadhu.
∴ All the sons of Sadhu cannot remove this log of wood. (jointly)

3. Fallacy of Division

This fallacy arises if we proceed from the collective use of a term to its distributive use.

All the angles of a triangle are equal to two right angles.
Angle ABC is an angle of the triangle.
∴ Angle ABC is equal to two right angles.

The angles of a triangle taken together are equal to two right angles. Taken separately, none of them can be equal to two right angles.

All the trees of the park give a thick shade.
This palm tree is a tree of the park.
∴ This palm tree gives a thick-shade.

What is true of all the trees taken together, cannot be true of a tree when taken by itself.

It may be noticed that the fallacies of Composition and Division are converse of each other, and both arise because of the ambiguous use of the middle term. In fact they are the two forms of the same fallacy. In order to distinguish them it is necessary that the argument be put in the logical order. If we ignore the order of the premises, one fallacy will appear as the other.

4. Fallacy of Figure of Speech

This fallacy arises from the supposition that words similar in form are also similar in meaning. The word 'visible' means capable of being seen, and 'audible' means capable of being heard; but 'desirable' means not *capable* of being desired but *worthy* of being desired. Mill commits this fallacy in his book Utilitarianism.

Whatever people desire is desirable.
Happiness is desired by people.
∴ Happiness is desirable.
The argument is obviously wrong.

The Fallacy of Paronymous Terms comes under this fallacy. Paronymous terms are the words of different parts of speech derived from the same root. But paronymous terms are not necessarily similar in meaning :

The teacher dictates and the students write.
∴ The teacher is a dictator and the students are writers.

The argument is fallacious because 'dictator' does not mean ne who dictates something, but a ruler having supreme irresponsible authority. Similarly, 'writer' means an author.

This man has divided our family property.

∴ This man is a divider.

The argument commits the fallacy of Paronymous terms because 'divider' does not mean one who divides, but it means a eometrical instrument.

5. *Fallacy of Amphiboly or Amphibology*

This fallacy arises due to the ambiguous meaning of a sentence because of its construction. An amphibolous sentence is one which, because of its construction, is capable of being interpreted in at least two different ways. So, it is not possible to determine which meaning it is intended to convey.

'He was given twice two and three rupees.'

It may mean that he was given either seven or ten rupees.

'He went to Calcutta on Monday, witnessed the Horse Race and returned the day after.'

It may mean that the Horse Race was on Monday and he returned on Tuesday, or it may mean that he returned on the next day of the Horse Race which was on some day other than Monday.

It may be noticed that the Fallacy of Amphiboly is not an inferential fallacy.

6. *Fallacy of Accent*

This fallacy arises due to the misplaced accent or emphasis on any expression in a sentence.

'Thou shalt not bear false witness against thy neighbour'

One may give emphasis on *against* and interpret the sentence as meaning that it is not wrong to bear false witness *in favour of* a neighbour.

'You sold this horse to me.'

The meaning of the sentence changes as we shift the emphasis from one word to another.

Emphasis on *you* means you sold, not your father or brother or anybody else.

Emphasis on *sold* means that you sold, did not give it as a gift or in lieu of something else.

Emphasis on *this* means this particular horse, not some other horse.

Emphasis on *horse* means you sold the horse, not a cow or a buffalo.

Emphasis on *to me* means you sold it to me, not to anybody else.

It may be noticed that the fallacy of Accent also is not an inferential fallacy.

7. *Fallacy of Accident*

This fallacy arises due to the application of what is true under one circumstance in a case under different circumstances. So we commit this fallacy when we argue from a general rule to a special case, e.g.,

Water is liquid.
Ice is water.
∴ Ice is liquid.
What man has done, man can do.
Kalidas wrote excellent Sanskrit dramas.
∴ Any man can write excellent Sanskrit dramas.

Similarly, we commit this fallacy when we argue from a special case to a general rule, e.g.,

"Do you recognise this woman covered in the blanket ?"
"No" "Then you do not recognise your mother."

Ice is solid.
Ice is water.
∴ Water is solid.

This fallacy is also committed when we argue from one special to another special case, e.g.,

To inflict pain on another is wrong.
The surgeon inflicts pain on another when he performs an operation.
The surgeon does something wrong.
Cotton-made things are comfortable to wear in Summer.
Pillow-cases are cotton-made things.
Pillow-cases are comfortable to wear in Summer.

This form of the fallacy is also illustrated when we confuse ween the essential and the inessential qualities.

"Am I different from you ?" "yes"
"Am I a man ?" "yes"
"Then you are not a man."
To call you an animal is to speak the truth.
To call you a monkey is to call you an animal.
∴ To call you a monkey is to speak the truth.

EXERCISE

1. What is meant by Fallacy ? Distinguish between Non-inferential, Inferential and Semilogical fallacies with examples.
2. What are the different kinds of Semilogical Fallacies ? Explain and illustrate them.
3. Name the fallacies of Immediate Inference and give two examples in each case.
4. Write short notes on :
   - (a) Fallacy of four Terms
   - (b) Fallacy of Illicit Major
   - (c) Fallacy of Illicit Minor
   - (d) Fallacy of Undistributed Middle.
5. Test the validity of the following immediate inferences.
   - (a) The Mahanadi is the longest river of Orissa.
     ∴ The longest river of Orissa is the Mahanadi.
   - (b) All Vaisnavas are Hindus. So all Hindus are naturally Vaisnavas.

(c) No teachers are fools, since all teachers are wise.

(d) All women are not widows. So, how can all widows be women ?

(e) Some men are honest politicians.
∴ Some dishonest politicians are not men.

(f) All fathers are major.
∴ All sons are minor.

(g) Some healthy people are unhappy.
∴ Some unhealthy people are not unhappy.
i.e., Some unhealthy people are happy.

(h) It is not true to say that all the Indians are uneducated. Therefore, it also not true to say that some Indians are uneducated.

(i) There is evidence that some workers of this institution are Naxalites. S it is false to assert that some workers of this institution are not Naxalites

(j) It is undoubtedly false that all men are honest. So it is undoubtedly tru that no men are dishonest.

(k) All kings are rich. ∴ All subjects are poor.

(l) 'Some fruits are not sweet' is a true statement. So, 'No fruits are swee is also a true statement.

6. Distinguish between the following :
   (a) Fallacy of Composition and Fallacy of Division
   (b) Fallacy of four terms and Fallacy of Equivocal terms
   (c) Fallacy of Amphiboly and Fallacy of Accent.

7. State the rules, which when violated, lead to the following fallacies. Point ou the exceptions , if there be any :
   (a) Fallacy of Undistributed Middle
   (b) Fallacy of Affirming the consequent
   (c) Fallacy of Denying the antecedent.

8. Write short notes on :
   (a) Fallacy of Figure of Speech
   (b) Fallacy of Accident
   (c) Fallacy of Material Obversion.
   (d) Fallacies of Inference by opposition.

9. Explain the fallacies of Mixed Syllogisms.

Test the validity of the following :

a) Ram is the son of Dasaratha. Laba is the son of Ram.
∴ Laba is the son of Dasaratha.

b) Some pets are beasts. Some pets are birds.
∴ Some beasts are birds.

c) Orissa is included in India. India is included in Asia.
∴ Orissa is included in Asia.

d) All Hindus are not Saivaite.
This man is a Saivaite.
∴ This man is not a Hindu.

(e) All criminals should be punished.
Ram is not a criminal.
∴ Ram should not be punished.

(f) Even sinners are not objects of hatred, because they are created by God, and nothing created by God can be an object of hatred.

(g) Only the ignorant think themselves to be omniscient.
God is omniscient. So God is ignorant.

(h) All wise people are respectable.
All wise people are non-jealous.
∴ All non-jealous people are respectable.

(i) Snakes are cruel. Criminals are cruel.
∴ Snakes are criminals.

(j) Ear-rings are ornaments. Ornaments are costly.
∴ Ear-rings are costly.

(k) Children are not youths. Youths are not old men. So children are not old men.

(l) Some flowers are not scented. Some flowers are beautiful. So, some beautiful things are not scented.

(m) If you are fated to be happy, you get wealth without labour. He is fated to be happy, since he is getting wealth without labour.

(n) If one is intelligent, learning becomes easy. This boy is not intelligent, how can he be learned ?

(o) If you are too much drunk, you die. The patient is dead. So he must hav drunk too much.

(p) Every politician is either patriotic or rich. This politician is rich. Therefo he is not patriotic.

(q) Happy people are either rich or learned or virtuous. This happy man rich. Therefore he is neither learned nor virtuous.

(r) You could not have been born both in India and in Pakistan. Since yo are not born in Pakistan, you must have been born in India.

(s) If the king is weak, there is loss of life and property. If the king is powerf there is loss of individual liberty. In India there is no king. So in India the is no possibility of either loss of life and property or loss of individu liberty.

(t) Greed leads to sin. Sin leads to death.

(u) All cold is expelled by heat. This person's disease is cold.

So this person's disease can be expelled by heat.

(v) Beggars are punishable by law. Vinobaji begs land from people. So he punishable by law.

(w) Half a loaf is better than nothing. Nothing is better than wisdom. So h a loaf is better than wisdom.

(x) The books of Sankaracharya cannot be read within an hour. Mo Mudgara is a book of Sankaracharya. So it cannot be read within an ho

(y) A child cannot raise this load. So all the children of the school can raise this load.

(z) Ram reads in I. A. class of this College.

∴ Ram is a Reader of this College.

10

Symbolic Logic

Nature of Symbolic Logic

Symbolic Logic is a development of Traditional Logic. It is now realised that Traditional Logic covers only a small, though imporant, part of the scope of what may properly be called Logic these days. Modern Logic is a well-developed and rapidly growing science.

This progress of Logic has been possible because of its association with the other formal science, Mathematics, which has developed enormously during the last two centuries and of course, the current one. These days, the theory of logical inference plays an important role both in mathematics and in empirical sciences. It is realised more than ever in the past that every branch of systematic knowledge, whatever be its field of enquiry, cannot but be organised in accordance with logical standards.

The most important function of Traditional Logic has been to provide methods of testing the validity of arguments. For this it is necessary to classify arguments into different types and to notice the logical form of each type of argument. By the use of a suitable set of symbols it is possible to bring out very clearly the logical character of any statement and its implication. Thus symbolisation facilitates the formulation of principles of validity of the different types of reasoning that are used in our everyday life and in the sciences.

C. I. Lewis has noted three distinguishing characteristics of symbolic logic. They are : (i) The use of ideograms, (ii) Application of the deductive method and (iii) The use of variables with a definite range of significance.

(i) Ideograms should be distinguished from phonograms (phono = sound, gram = symbol). Every word of the language is a phonogram. It directly stands for the sounds that we make while depends on the truth-value of the propositional variables. As for example, ~p is a truth–function of p, because the truth or falsity of ~p depends on the truth or falsity of p. When p is true, ~p is false; when p is false, ~p is true. Similarly, p.q, pvq, $p \supset q$, $p \equiv q$ etc. are truth–functions of p and q.

Truth–tables

Truth-table is a convenient way to show the truth-value of a truth –function, taking into consideration all possible truth–values of the propositional variables involved in it. So the truth-table is a definition of the truth–function.

Every proposition can be either true or false. So the truth-value of every constituent propositional variable can be written as 1 (True) or 0 (False) and the corresponding truth-value of the truth–function can be similarly indicated.

If there be two constituent propositional variables, the possible combinations from the stand-point of their truth-values are True-True, True-False, False-True and False-False. The more the number of constituent propositions, the more the number of such possible combinations.

Let us construct truth-tables of some simple and basic truth functions.

(i) The Contradictory Function

Obviously, if p (e.g., Ram is tall) is true, then ~p (Ram is not tall) is false and if p is false,then ~p is true. One is the contradictory of the other. So the truth-table of the Contradictory Function is as follows :

p	~p
1	0
0	1

(ii) The Conjunctive Function

A conjunctive proposition, e.g., Ram has gone to Calcutta (p) and Hari has gone to Bombay (q) is true only when both the constituent propositions are true. If any or both of them are false, the whole statement becomes false. So the truth-table of the Conjunctive Function is as follows :

p	q	p . q
1	1	1
1	0	0
0	1	0
0	0	0

(iii) The Alternative Function*

An alternative proposition, e.g., Ram is either intelligent (p) or he is diligent(q) is true, when any one or both the alternatives are true. It is false only when both the alternants are false. So, the truth-table of the Alternative Function is as follows :

p	q	p v q
1	1	1
1	0	1
0	1	1
0	0	0

(iv) The Implicative Function

An implicative proposition of the form if p, then q is interpreted in logic as either p is false or q is true, because it is the minimum condition which must be fulfilled in order to assert such a proposition. So the truth-table of the Implicative Function is constructed thus :

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*In some Textbooks, this function is named as Disjunctive function.

p	q	p⊃q
1	1	1
1	0	0
0	1	1
0	0	1

(v) The Equivalence Function

Two propositions are equivalent, if they are simultaneously true and simultaneously false. So the truth-table of the Equivalence Function is as follows :

p	q	p≡q
1	1	1
1	0	0
0	1	0
0	0	1

Tautology, Contradictory and Contingent Propositional formulae

If a truth function is always true, whatever be the truth-value of its constituent propositions, it is said to be valid or logically true or a tautology.

If a truth function is always false, whatever be the truth-value of its constituent propositions, it is said to be contravalid or logically false or a contradiction.

If a truth function is sometimes true and sometimes false depending on the truth-value of its constituent propositions, it is said to be a contingent propositional formula.

As for example, p∨~p is a tautology, p.~p is a contradiction but all the formulae truth-tabled above are contingent. The truth-tables show that they are sometimes true and sometimes false. The digits below the main column (called the matrix number) are sometimes 1 and sometimes 0. In the case of a tautology, the matrix umber contains only 1's and in the case of a contradiction it ontains only 0's.

p	$\sim p$	$p \vee \sim p$
1	0	1
0	1	1

p	$\sim p$	$p . \sim p$
1	0	0
0	1	0

Testing the validity of arguments with the help of truth-tables

Truth-tables provide one of the methods of testing the validity of some types of arguments. An argument is said to tbe valid, when the matrix number of the corresponding truth table contains only 1's, *i.e.*, when the truth-function is a tautology. Let us take some examples.

Example 1

If there is the sun, there is light and there is the sun.
∴ There is light. It is of the form If p, then q; and p; ∴q

Symbolic expression : $((p \supset q).p) \supset q$

Truth-table

I	II	III	IV	V
p	q	$p \supset q$	$(p \supset q) \cdot p$	$((p \supset q) \cdot p) \supset q$
1	1	1	1	1
1	0	0	0	1
0	1	1	0	1
0	0	1	0	1

Explanation

Columns I and II give all possible combinations of the truth-values of p and q. In column III, the truth-value of $p \supset q$ is determined in accordance with the truth-table of the implicative function. In column IV, the truth-value of $(p \supset q) . p$ is determined by connecting column III with column I in accordance with the truth-table of the conjunctive function. Finally, in column V, the truth-value of $((p \supset q).p) \supset q$ is determined by connecting column IV with column II.

The main, i.e., the last column contains only 1's. So it is a tautology. The argument is valid.

Example 2

If there is the sun there is light; and there is light.
∴ There is the sun.
It is of the form If p, then q; and q; ∴ p.

Symbolsic expression :—$((p \supset q).q) \supset p$

Truth-table

I	II	III	IV	V
p	q	$p \supset q$	$(p \supset q) . q$	$((p \supset q) . q) \supset p$
1	1	1	1	1
1	0	0	0	1
0	1	1	1	0
0	0	1	0	1

Explanation

I, II & III are obvious, IV connects III with II and V connects IV with I.

The main, i.e., the last column contains both 1's and 0. So it is not a tautology. The argument is invalid.

ample 3

Ram is either intelligent or diligent. He is not intelligent.

∴ He is diligent.

Ram is intelligent—p

Ram is diligent—q

ymbolic expression :—((p v q) . ~ p) ⊃ q

ruth–table :

I	II	III	IV	V	VI
p	q	p v q	~ p	(p v q) . ~ p	((p v q). ~ p) ⊃ q
1	1	1	0	0	1
1	0	1	0	0	1
0	1	1	1	1	1
0	0	0	1	0	1

Explanation

I, II and IIIare obvious, IV is obtained from I by the principle of contradictory function.

V connects III with IV and VI connects V with II.

The main, i.e., the last column contains only 1's. It is a tautology. The argument is valid.

Example 4

Not both that you were born in January as well as in February. You were not born in January.

∴ You were born in February.

You were born in January—p

You were born in February—q

Symbolic expression :— $(\sim(p \,.\, q) \,.\, \sim p) \supset q$

Truth–table

I	II	III	IV	V	VI	VII
p	q	$p \cdot q$	$\sim(p \cdot q)$	$\sim p$	$\sim(p \cdot q) \cdot \sim p$	$(\sim(p \cdot q) \cdot \sim p) \supset q$
1	1	1	0	0	0	1
1	0	0	1	0	0	1
0	1	0	1	1	1	1
0	0	0	1	1	1	0

Explanation

I, II and III are obvious. IV is obtained from III; V is obtained from I; VI connects IV with V; VII connects VI with II.

The final column contains both 1's and O.

It is not a tautology. The argument is invalid.

In the above discussion, there was no need to analyse the propositions to their non-propositional elements. The constituent propositions have been taken as units and compound propositions are built out of them. Now, let us pay attentiaon to the internal structure of simple and general propositions and see how they are symbolised.

Simple Propositions

A simple proposition cannot be analysed into other propositions as its constituents. It states something about one individual or states of some relation where more than one individual are involved. Simple propositions may be of several types.

(1) Class–membership proposition

Anand is a professor.

This bird is a parrot.

Such propositions are class–membership propositions. Here an individual is said to be a member of a class. It is symbolised as $a \in F$.

The small letter 'a' stands for the individual, the capital letter F stands for the class, and the symbol $\in$ stands for class–membership relation. So it means the individual, 'a' belongs to the class F. The constituents a and F may change, but the component $\in$ is retained. So we could have equally well symbolised the propositions as $b \in G$ or $c \in H$. Using the variable symbol x to stand for any individual indifferently we can symbolise all such propositions as $x \in A$.

The denial of a class–membership proposition, e.g., Anand is not a professor or this bird is not a parrot, can be symbolised as $\sim (a \in F)$. Sometimes it is symbolised as $a \in \bar{F}$. Similarly, the negation of $x \in A$ is either $\sim (x \in A)$ or $x \in \bar{A}$

(ii) Subject–predicate proposition

A simple subject–predicate proposition has an individual as subject and an attribute or property or descriptive phrase as predicate, e.g., Anand is fat, this bird is green. It can be symbolised as fa, gb, hc,etc. Here the small letters a, b, c,etc. stand for the individuals, i.e., the subject and the small letters f, g, h, etc. stand for the properties, i.e., the predicate. Conventionally the symbol for the property is stated first and then the symbol for the individual is mentioned. Using a variable symbol for the individual, it can be symbolised as Φx (Φ is the greek letter phi)

The denial of such propositions can be symbolised as $\sim fa$, $\sim gb$, $\sim hc$ or $\sim \Phi x$.

(iii) Relational proposition

A simple relational proposition asserts a relation between two or more individuals. The constituents or terms of relation are individuals, e.g., Anand is taller than Bikash, Ram is married to Sita, The Himalayas is to the north of India,etc. Such propositions are symbolised as aRb, or R(a, b). The small letter a, b, c etc. stand for individuals and the capital letter R stands for the relation. Using variable symbols, x, y, z, for any individuals whatever, we can state them as xRy or R (x, y).

In a relational proposition, the relation proceeds from one individual to the other. So it has a sense or direction of relation. The relation 'taller than' does not just exist between Anand and Bikash, but proceeds from Anand to Bikash. Anand has the relation (taller than) to Bikash not that Bikash has the relation (taller than) to Anand. So the direction of relation is important here. The term from which the relation proceeds is called referent (e.g., Anand, Ram, the Himalayas). The term to which the relation proceeds is called relatum (e.g., Bikash, Sita, India). The convention is to state the referent to the left of R and the relatum to the right of R in xRy. In R(x,y) the referent is stated first inside the brackets and then the relatum is stated.

The same relation, e.g., 'taller than' may be there between many pairs of referent and relatum.. All the referents and relata taken together constitutes what is called the domain of the relation. A domain containing a limited number of individuals is said to be finite and a domain containing an unlimited number of individuals is said to be infinite.

A relation may have more than two terms of relation, e.g., Ram gives a ring to Sita. Here there are three terms of relation,i.e., 'Ram', 'a ring' and 'Sita' and the relation is 'giving'. Such propositions can be symbolised as R (x, y, z). Relational propositions having larger number of terms can be similarly symbolised.

The denial of relational propositions is symbolised as ~R (x,y), ~ R(x, y, z) and so on.

General Proposition

General propositions are about classes. They may be of several types.

(i) Existential Proposition

There are ghosts.

Horses exist.

Obviously such propositions are neither about an individual or about a property. They state about the existence of something. hey are analysed as :

There is something, which is a ghost.

There is something, which is a horse.

Using the variable symbol x for 'something', they can be stated s :

(There is an x) (x is a ghost).

(There is an x) (x is a horse).

Such propositions are symbolised as :

$(\exists x)(fx)$

The symbol '$\exists x$' stands for 'there is an x' and is said to be existential quantifier or particular quantifier, f (or g, h, Φ (phi), ψ (psi),etc.) is a predicate symbol standing for 'is a ghost', ' is a horse', etc.; the variable symbol x (or y, z,etc.) stands for whatever that something is which has the predicate f.

The denial of such propositions, e.g., There are no ghosts or Horses do not exist can be symbolised as :

$\sim(\exists x)(fx)$

(ii) One–predicate universal Proposition

Everything is destructible.

Nothing is permanent.

Such propositions assert or deny a property of the whole universe and can be stated as :

(Whatever x may be) (x is destructible).

(whatever x may be) (x is not permanent).

They can be symbolised respectively as

$(x)(fx)$

$(x)(\sim gx)$

Here (x) is said to be a universal quantifier.

(iii) General proposition about class inclusion or class exclusion

(a) All men are mortal.

(b) No birds are quadruped.

(c) Some fruits are sweet.

(d) Some books are not interesting.

Such propositions state that one class is wholly or partially included in or excluded from another class. From our discussion on existential import (Chapter V), pages (96—99) we know that (a) and (b) do not signify the existence of things. They express a relation of implication between two properties. We also know from that discussion that (c) and (d) signify the existence of things. They express a relation of conjunction between two properties in those things. So (a) and (b) are symbolised with universal quantifiers, but (c) and (d) are symbolised with existential quantifiers.

Accordingly,

(a) may be analysed as :

(whatever x may be), (if x is a man, then x is mortal).

(b) may be analysed as :

(whatever x may be), (if x is a bird, then x is not a quadruped).

(c) may be analysed as :

(There is an x) (x is a fruit and x is sweet).

(d) may be analysed as :

(There is an x) (x is a book and x is not interesting).

Therefore, they are symbolised as :

(a) $(x)\ (fx \supset gx)$

(b) $(x)\ (fx \supset \sim gx)$

(c) $(\exists x)\ (fx \, . \, gx)$

(d) $(\exists x)\ (fx \, . \sim gx)$

Interchangeability of Quantifiers

It can be seen from the above section that the propositions dealt by the Traditional Logicians, i.e., A,E,I and O propositions are nothing but general propositions about class inclusion and class exclusion. We, further, know that A and O as well as E and I are contradictory of each other. So all these propositions can be expressed with either universal quantifiers or particular quantifiers.

A—All S is P : $(x)(fx \supset gx)$ or $\sim (\exists x)(fx \cdot \sim gx)$

E—No S is p : $(x)(fx \supset \sim gx)$ or $\sim (\exists x)(fx \cdot gx)$

I—Some S is P : $\sim (x)(fx \supset \sim gx)$ or $(\exists x)(fx \cdot gx)$

O— Some S is not P : $\sim (x)(fx \supset gx)$ or $(\exists x)(fx \cdot \sim gx)$

Free and Bound variables

A symbolic expression may have one or more variables and they are either quantified or not quantified. If a variable is not quantified, it is said to be free; if it is quantified, it is said to be bound.

As for example,

In fx, x is a free variable.

In $fx \supset gy$, x and y are free variables.

In $(x)(fx \supset gy)$, x is a bound variables, but y is a free variable.

In $(\exists x)(\exists y)(fx \vee gy)$, both x and y are bound variables.

Set Theory

The set theory also deals with individuals and classes. A class or collection of well-defined objects is called a set. 'All tall men of India' can be said to be a class, but not a set, since 'tall' is not properly defined. 'All tall men of India above 6 ft.' is a set.

The set theory plays an important role in mathematical discussion and has brought diverse branches of Mathematics like Algebra, Geometry, Analysis,etc. under a single system.

If any individual whatever is said to belong to a set it is symbolised as $x \in A$. It represents propositions like 'Sita is a woman', '2 is an even number.' Its denial is symbolised as $x \notin A$.

If one set is said to have exactly the same members as another set, it is symbolised as $A = B$. It represents propositions like 'All human beings are rational animals,' 'Equilateral triangles are equiangular triangles'. Its denial is symbolised as $A \neq B$.

Let us note the meanings of some other symbols of the set theory.

$x > y$ means x is greater than y.

$x < y$ means x is less than y.

$A \subset B$ means A is a sub set of (included in)B.

$A \supset B$ means A is a super set of (includes) B.

$A \cup B$ means the union of sets A and B.

$A \cap B$ means the intersection (common elements) of sets A and B.

$A \sim B$ means the remainder of the set A when set B is excluded from it.

Various Methods of testing the validity of arguments

Considering the logical character of the Relation existing between terms, several inferences can be intuitively realised to be valid and others to be invalid, e.g.,

Ram marries Sita;
∴ Sita marries Ram—valid.
Ram loves Sita;
∴ Sita loves Ram—invalid.
Ram is taller than Hari, Hari is taller than Govind;
∴ Ram is taller than Govind—valid.
Ram is father of Hari'; Hari is father of Govind;
∴ Ram is father of Govind—invalid.

So we cannot say that xRy.

∴ yRx is always valid. It is valid according as R is a symmetrical relation or not.

Similarly, x R y and y R z

∴ x R z is valid or invalid according as R is a transitive relation or not.

Implication and class-inclusion are transitive relations.

So $(fx \supset gx)$, $(gx \supset hx)$,

∴ $(fx \supset hx)$ is valid.

Similarly, $A \subset B$, $B \subset C$,

∴ $A \subset C$ is valid.

But class-exclusion is not transitive.

So $A \notin B$; $B \notin C$,

∴ $A \notin C$ is not valid.

Intuition being not a safe guide, Symbolic Logic formulates dependable principles of inference and makes use of many techniques for convenience.

It may be noticed that construction of truth-tables is not the only method of testing the validity of reasonings, though it is a primary one. In different cases, different methods are useful and convenient. Indirect truth-table methods, Reduction to Conjuctive Normal Form. Method of Equivalent substitution or sentential Derivation Method, Consideration of simultaneous satisfiability, Method of Boolean Algebra are some of the other techniques that help the testing of the validity of arguments.

It should not, however, be supposed that the contribution of Symbolic Logic is confined to only providing better methods of testing the validity of all sorts of arguments. Symbolisation makes ordinary language precise as well. But the most important contribution of Symbolic Logic seems to be building up of pure deductive systems by deriving all logically true propositions or tautologies from a set of Axioms, which serves as the ideal of all scientific pursuit of systematic knowledge.

Exercise

1 Explain the nature of symbolic logic.
How is it related to traditiona logic ?

2. Write explanatory notes on :
   (a) propositional variables (b) logical constants
   (c) truth–functions (d) truth–tables.

3. Construct truth–table for each of the following :
   (a) Contradictory function (b) Conjuctive function
   (c) Alternative function (d) Implicative function
   (e) Equivalence function.

4. Distinguish between tautological, contradictory and contingent propositional formulae.

5. Write brief notes on :
   (a) class–membership proposition
   (b) relational proposition
   (c) existential proposition
   (d) one–predicate universal proposition.

6. Distinguish between :
   (a) simple proposition and general proposition
   (b) existential quentificer and universal quantifier
   (c) free variable and bound variable.

7. How is a set different from a class ?
   Explain with illustrations the meaning of :
   (a) $A \subset B$ (b) $A \supset B$
   (c) $A \cup B$ (d) $A \cap B$

8. Test the validity of the following by constructing truth tables :
   (a) If this ring is made of god, it is costly. This ring is not made of gold. So it is not costly.
   (b) Either John or Joseph is the captain. John is not the captain. So Joseph is the captain.
   (c) Not both that Ram is at Calcutta and at Bombay now. He is not at Calcutta now. So he is now at Bombay.

9. State what kinds of propostions the following are and symbolize them :
   (a) This leaf is not green.
   (b) My father is older than my mother.
   (c) No dragon exists.
   (d) Everything is created by God.

10. Express the A, E, I, O propositions of the Traditional Logic by using universal and particular quantifiers.

C.H.S.E. QUESTIONS

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Group – A

Answer all questions

1. (a) State the law of identity.
   (b) What do mean by a denotation of a term ?
   (c) Name the different types of propositions according to quality.
   (d) Give an example of privative term.
   (e) Which figure is called perfect figure ?
   (f) State a general rule of Syllogism.
   (g) Give an example of circular definition.
   (h) Give one of the Special Syllogistic rule of figure III.
   (i) What is hypothetical-categorical syllogism ?
   (j) Give the symbol of Equivalence function.

2. Fill in the blanks :
   (a) A term which cannot be the subject or predicate or part there of in a proposition is called —.
   (b) In obversion, the given proposition is called —.
   (c) The symbol of conjuctive function is —.
   (d) In 'O' Proposition the — term is distributed.
   (e) Bramantip is a mood of — figure.
   (f) The obverse of A is —.
   (g) When the major term is distributed in the conclusion without being distributed in the premise the fallacy is called
   (h) In the first figure of syllogism — term is subject of minor premise.
   (i) Every Syllogism must have — number of propositions.
   (j) The relation between A and O Proposition is —.

Group – B

3. Answer any ten questions
   (a) Distinguish between a word and a term.
   (b) Distinguish between genus and species.

(c) What do mean by physical division ?

(d) Explain with examples the distinction between contrary and contradictory terms.

(e) What is dilemma ?

(f) Give a symbolic example of mood Cesare.

(g) What are the variables in symbolic logic ?

(h) State the rules of obversion.

(i) What is a particular proposition ?

(j) Define immediate inference.

(k) What is simple conversion ?

(l) Explain the structure of syllogism.

(m) Name the fallacy of following argument :

If there is rain, the ground is wet.
There is no rain.
The ground is not wet.

(n) Give an example of fallacy of four-terms.

Group – C

Answer any **four** questions :

4. Are proper names connotative ? Discuss.
5. Explain the rules of conversion.
6. Explain the classification of propositions according to mixed principles of quality and quantity with examples.
7. Prove the following :
   - (A) No conclusion follows if the major premise is particular and the minor premise is negative.
   - (B) In the second figure one premise must be negative.
8. Write short notes on the following :
   - (A) Fallacy of equivocation.
   - (B) Fallacy of definition.
9. Reduce Camenes both directly and indirectly.
10. Explain the nature of symbolic logic. How it is related to traditional logic ?

1997–(A) Paper – I

(As per 1997 Syllabus)

Group–A

1. (a) State the law of identity.
   (b) State one important distinction between term and word.
   (c) State the relationship between denotation and connotation of a term.
   (d) What is a relative term ?
   (e) What do you mean by differentia ?
   (f) Give an example of circular definition.
   (g) What is meant by metaphysical division ?
   (h) What is a Syllogism ?
   (i) Give a symbolic example of 'Baroco'.
   (j) Name the valid moods in Figure I.
2. Fill in the blanks:
   (a) If a term has both connotation and denotation, it is called a —— term.
   (b) Logical division is always division of a ——.
   (c) According to relation, propositions are divided into —— and ——.
   (d) The obverse of an 'A' proposition is —— proposition.
   (e) 'Camestres' is a valid mood of —— figure.
   (f) 'Baroco' can be directly reduced to ——
   (g) In the second figure, the major premise must be ——.
   (h) In a syllogism if one of the premises is particular, the conclusion is ——.
   (i) In a simple dilemma, the conclusion is always a —— proposition.
   (j) According to Aristotle's dictum, —— figure alone is the valid figure.

Group–B

3. Answer any ten questions:
   (a) Distinguish between inference and argument.
   (b) What is a predicable ? Name the different kinds of predicables.
   (c) Reduce the following sentences to their logical form.

(i) Educated men are seldom foolish.
(ii) Man is sometimes selfish.

(d) Find out the obverses of the reduced propositions in part question (c) above.

(e) What is meant by conversion per limitation ?

(f) Construct the truth-table of the contradictory function.

(g) State the Special rules of Figure III.

(h) Explain the fallacy of four terms.

(i) How is a dilemma rebutted ?

(j) What is a major premise in a syllogism ?

(k) What is the fallacy of affirming the consequent ?

(l) Give an example of disjunctive-categorical syllogism.

(m) Explain what is meant by a dilemma.

(n) What is fallacy of illicit minor ?

Group–C

Answer any four questions:

(4) Explain the difference between truth and validity. How is Logic connected with them ?

(5) Distinguish between abstract and concrete terms. Discuss whether abstract terms are singular or general.

(6) Test the following definitions and divisions.

(a) Man is a human being.
(b) Cow is a domestic animal.
(c) Schools are divided into Oriya, English and Telugu.
(d) Men are divided into Indians, Europeans, white and educated.

(7) What is a Copula ? Discuss its nature.

(8) Discuss the role of Variables and Constants in symbolic logic.

(9) Prove the following :

(a) In a syllogism, if one premise is negative, the conclusion must also be negative.
(b) In the first figure, the major premise is always universal and the minor affirmative.

(10) Reduce 'Bocardo' both directly and indirectly.

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(As per 1996 Syllabus)

Group-A

(a) What is a term ?

Give an example of a circular definition.

(c) Which term is distributed in a universal affirmative proposition ?

(d) Give the symbol for the conjunctive function.

(e) Give an example of a physical division.

(f) Name the different kinds of induction improperly so called.

(g) What are the quantitative marks of cause ?

(h) State the law of uniformity of nature.

(i) Define unscientific induction.

(j) What is representative fiction ?

Fill in the blanks

(a) The obverse of 'E' proposition is ——.

(b) If the converted and the converse are equivalent propositions, the process is called —— conversion.

(c) Definition of a term is the explicit statement of its ——.

(d) The relation between 'E' and 'A' propositions is ——.

(e) According to the mixed principle of quality and quantity, propositions are of —— types.

(f) If a term has only one meaning, it is called a —— term.

(g) The formal ground of unscientific induction is ——.

(h) In perfect induction there is no ——.

(i) The process of passing from some to all is called ——.

(j) When a hypothesis is verified, it becomes ——.

Group-B

3. Answer any ten questions

(a) Distinguish between abstract and concrete terms.

(b) What is ostensive definition ?

(c) What is the fallacy of cross division ?

(d) State the rules of conversion.

(e) Distinguish between privative term and negative term.

(f) What is material obversion ?

(g) Construct the truth-table for the equivalence truth-function.

(h) What is inductive leap ?

(i) What is the relation between cause and condition ?

(j) What is conjunction of causes ?

(k) Distinguish between analogy and unscientific induction.

(l) Point out the importance of hypothesis in induction.

(m) Why colligation of fact is not considered as induction proper ?

(n) What is called permanent cause ?

Group–C

Answer any four questions

4. 'Denotation and Connotation vary inversely'. Discuss.
5. Explain the rules of logical division.
6. State and explain the rules of obversion. Determine the obverses of 'A' and 'E' propositions.
7. Explain the characteristics of scientific induction.
8. Explain the conditions of a legitimate hypothesis.
9. Explain the scientific view of cause.
10. Write short notes on :
    (a) Truth function
    (b) Paradox of induction

1996 - (A) Paper-I

1. Answer all questions:

   (a) Give an example of a privative term.

   (b) What do you mean by connotation of a term ?

   (c) Give an example of figurative definition.

   (d) Name the propositions contradictorily related.

   (e) Which term is distributed in a particular negative proposition?

   (f) Mention the different kinds of induction proper.

   (g) Give the definition of analogy.

   (h) What is a condition ?

   (i) What is the qualitative mark of a cause ?

   (j) What are the formal grounds of induction ?

2. Fill in the blanks :

   (a) Non-verbal denotative definition is called — definition.

   (b) If the quantity of a proposition is not stated it is called a — proposition.

   (c) The obversion of I is —.

   (d) The relation between two propositions having the same meaning is called —.

   (e) If a term has only one meaning, it is said to be a — term.

   (f) Properly speaking, induction and deduction are — processes.

   (g) Unscientific induction is said to be induction per — enumeration.

   (h) In — intermixture of effects, the separate effects and the joint effect are of the same nature.

   (i) Cause in the sum total of —.

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(j) Hypothesis is a – supposition.

3. Answer any ten questions :

(a) Distinguish between words and terms.

(b) What is division by dichotomy ?

(c) Distinguish between a sentence and a proposition.

(d) What is fallacy of circular definition ?

(e) Define immediate inference.

(f) What do you mean by logical constants in symbolic logic ?

(g) Explain, with examples, the distinction between contrary and contradictory terms.

(h) What is fundamentum divisions ?

(i) Briefly explain the distinction between induction and deduction.

(j) What is the problem of induction ?

(k) What is meant by adequacy in the process of proving a hypothesis ?

(l) Why is induction by parity of reasoning not considered as an induction proper ?

(m) Give an example of analogy.

(n) What is plurality of causes ?

4. Explain the rules of connotational definition.

5. Explain the seven-fold relations of propositions.

6. State and explain the rules conversion. Determine the converses of A and E Proposition.

7. What is truth-function ? Construct truth-tables for alternative and equivalence truth-functions.

8. Explain the characteristics of unscientific induction.

9. Explain the law of Uniformity of Nature. Why is it called the formal ground of induction ?

10. Explain what constitutes the proof of a hypothesis.

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